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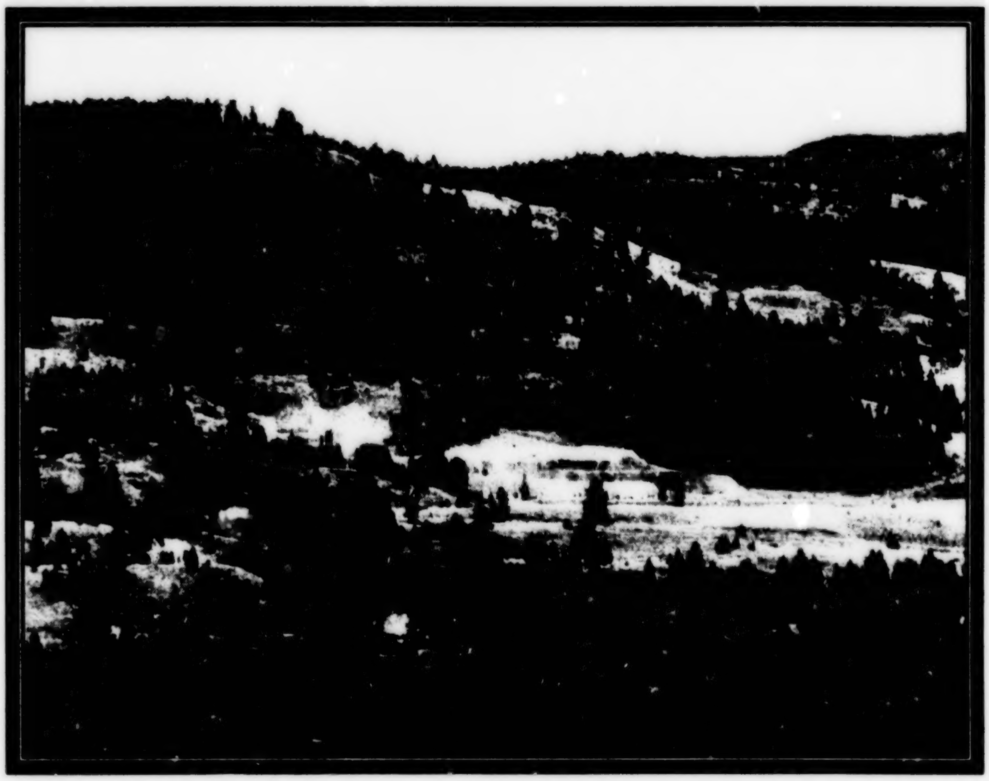
Bureau of Land Management
Spokane District Office, Spokane Washington
Border Resource Area

November 16, 1998

RECORD OF DECISION
and
Finding of No Significant Impact



Echo Bay Minerals Company
Lamefoot Mine
Plan of Operation Modification
WMP-130-89-019B

2002-006947/NF c

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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U.S. DEPARTMENT OF THE INTERIOR
BLM News
BUREAU OF LAND MANAGEMENT
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November 16, 1998

FOR IMMEDIATE RELEASE

LAMEFOOT MINE

NOTICE OF AVAILABILITY OF FINDING OF NO SIGNIFICANT IMPACT AND RECORD OF DECISION FOR MINE EXPANSION PLAN OF OPERATIONS MODIFICATION WMP-130-89-019B

The U.S. Department of the Interior, Bureau of Land Management (BLM), Spokane District, Washington has completed the review and analysis of Echo Bay Minerals Company's proposal to expand underground mining and exploration at the Lamefoot Mine in Republic, Washington. This review is consistent with BLM's decision of November 1994 to permit mine development within the initial project area. BLM completed an Environmental Assessment (No. EA-130-08-14) July 24, 1998, to determine the scope of impacts associated with the existing operations and life-of-mine projections for the expansions. The impacts identified are within the scope of those portrayed in the 1994 Lamefoot Mine Final Environmental Impact Statement Supplement and a 1995 Environmental Assessment for a previous expansion. The BLM has therefore issued a Finding of No Significant Impact (FONSI) and a Record of Decision authorizing the expansion of the underground mine. The Lamefoot Mine was originally scheduled to begin closure by the end of 1999. The expansion is expected to add about one year to the mine life.

Copies of the July 24, 1998 Environmental Assessment, FONSI and Record of Decision are available for review at the Republic, Omak, Oroville, Okanogan, Colville and Spokane Libraries, and at BLM offices in Spokane and Wenatchee, Washington. You may also examine these items by visiting BLM's website at www.or.blm.gov/spokane.

Copies of the ROD and FONSI are available on request from the Bureau of Land Management, Spokane District Office, Border Resource Area, at 1103 N. Fancher, Spokane, Washington, 99212-1275; or by calling BLM at (509) 536-1200.

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Record of Decision
November 16, 1998

Echo Bay Minerals Company
Lamefoot Mine Plan Modification
WMP-130-89-019B

INTRODUCTION

In 1996, project monitoring indicated that site conditions at the underground Lamefoot Mine appeared to be deviating from the projections used in the 1994 Final Environmental Impact Statement Supplement (FEISS) and the 1995 Environmental Assessment (9/20/95 EA) for the area encompassed in the authorizations for mining. BLM determined that the numerical modeling of subsidence, geochemistry and groundwater prepared for the 9/20/95 EA did not fully incorporate all test data and used a number of factors that were not considered to be representative or appropriate for the projected site conditions. In addition, monitoring showed that the life-of-mine projections of the quantity of potentially acid generating (PAG) rock provided for the 9/20/95 EA substantially underestimated the actual quantity of PAG waste rock that would be produced from the authorized operations and placed as backfill.

In December, 1996, a Plan of Operations was approved under 43 CFR 3809 for incorporation of requirements of the 11/30/94 Record of Decision (ROD) as modified by the 9/20/95 ROD. As an enforcement action in March, 1994, for noncompliance with some requirements of existing RODs, BLM directed Echo Bay Minerals Company (EBM) to revise the 1995 numerical models using a number of factors, such as all of the 1995 data and conclusions, site condition assumptions and model orientations determined by BLM and EPA, revised projections of subsidence effects on groundwater movement, updated tonnages for backfill composition, revised life-of-mine projections of backfill tonnages and composition, and actual groundwater drawdown effects from mining. Some groundwater technical evaluations were also required to verify new site conditions identified in 1997, and subsequent evaluations also determined the need for enforcement of other existing Conditions of Approval (COAs). The purpose of this technical and modeling analysis was to determine if a BLM-directed plan modification and additional mitigation was needed to address the changed conditions and noncompliance issues to prevent unnecessary or undue degradation from operations within the existing authorized areas and interim expansions by EBM. The analyses were to address the life-of-mine project activities, including effects of possible mine expansions.

During this same time period, EBM submitted plan of operations modifications that proposed expansions of underground mine workings into several new areas (mining upward and eastward of Zone 2 at the southern end of the mine, and deeper and northward into Zones 4, 5, 6; exploration into Zone 7 at the north end of the mine; and the 2225N exploration adit extending farther to the north). The Proposed Action involved applying all requirements from the existing Records of Decision (RODs) to the new underground expansion areas for the proposed exploration, development and mining activities. Surface activities at the Lamefoot Mine would continue to involve limited surface drilling of exploration holes and monitoring wells as analyzed in the 1994 FEISS and authorized in the 11/30/94 ROD. The Proposed Action would extend the mining phase of operations by about two months. Existing surface facilities at the Lamefoot Mine would continue to be used. Ore would continue to be processed in the existing State-authorized Key Mill on privately-owned lands.

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Alternative No. 2, Enlarged Interim Expansion, is essentially the same as the Proposed Action but this alternative would extend the mining phase of the mine operations at least one year by authorizing both development and mining in areas where the Proposed Action only proposes development operations.

This decision addresses BLM's analysis of the revised modeling of the current mine status and life-of-mine projections for site conditions and includes analysis of the proposed mine expansion areas and the need for additional mitigation. The analysis was coordinated with Federal, State, County and Tribal governments and agencies.

An Environmental Assessment (7/24/98 EA) was prepared to evaluate the potential impacts indicated by the technical studies and BLM's analyses and was issued on July 24, 1998. BLM evaluated the activities in the existing plan of operations and the proposed modifications for the Lamefoot Mine in the 7/24/98 EA following a detailed BLM re-examination of the 1994 and 1995 technical studies, evaluation of the current status of groundwater and backfill, and revised predictions for site conditions and impacts. The numerical models used in 1995 for analysis of subsidence, geochemistry and hydrology were substantially revised or replaced to ensure that all the technical data was considered, and that the models incorporated existing site conditions and conformed to assumptions of reasonably foreseeable potential future conditions. The analysis evaluated the current status of compliance with existing mitigation measures and the potential impacts of the operations as mitigated. In considering all of these factors, the 7/24/98 EA concluded that all impacts could be mitigated to the point of nonsignificance and uncertainties in predictive capabilities could be overcome if the existing mitigation measures are followed along with the additional mitigation and monitoring measures analyzed.

Public comments on the 7/24/98 EA were solicited by the BLM through August 14, 1998. Additional government-to-government consultation was subsequently conducted with the Confederated Tribes of the Colville Reservation. BLM held further discussions with EBM regarding conditions of approval for mitigation and monitoring as described in the 7/24/98 EA and application of the existing 11/30/94 and 9/20/95 RODs to the expansion areas, and a field inspection of new monitoring locations was performed.

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

BLM's review of the analysis of impacts as mitigated, as described in the 7/24/98 EA, resulted in a Finding of No Significant Impact (**Appendix II**) for the existing and proposed changes in the operations. Therefore, an environmental impact statement or supplement is not necessary. Based on this analysis process and its resulting conclusions, BLM reached this Decision.

DECISION

The decision of the BLM District Manager is to authorize the mine expansion based upon Alternative No. 2, Enlarged Interim Expansion (Agency Preferred Alternative), in the 7/24/98 EA. Operations shall be conducted in accordance with the 11/30/94 Record of Decision (ROD), as modified by the 9/20/95 ROD and additional Conditions of Approval (COAs) identified in this 1998 decision. Implementation of this decision as mitigated with the identified additional COAs will not cause unnecessary or undue degradation of the public lands. All requirements of these RODs will be implemented and enforced. Additional monitoring is needed to verify that ROD requirements are carried out and that actual impacts fall within the scope of the environmental analysis.

SUMMARY OF THE SELECTED ALTERNATIVE

Alternative No. 2, Enlarged Interim Expansion, involves expanded mining in Zones 2, 4 and 6, and development of access for exploration into Zone 7 and "north" North Lamefoot. New operations in Zone 2 include mining of ore above the 3070 ft. elevation of upper Zone 2 in seven lifts of drift and fill mining in the area between coordinates 7200E and 7600E; 25850N and 26400N; and elevations of 3085 ft. and 3200 ft. New operations in Zone 4 extension (Zone 4E) involve mining from existing development workings. New operations in the Zone 6 extension (Zone 6E) involve primary development and mining between coordinates 6500E and 700E; 27500N and 27850N; and between elevations of 2160 ft. and 2650 ft. Mining would be conducted with the provision that crown pillar mining widths stay approximately within those limits already evaluated (up to 215 ft. in Zones 1 and 2, and about 60 to 130 ft. in Zones 3, 4, 5, and 6). New operations in Zone 7 involve excavation of approximately 1500 ft. of ramp construction between coordinates 6400E and 7000E; 27100N and 28000N; and between elevations of 2100 ft. and 2225 ft. to conduct exploration drilling to delineate potentially acid generating (PAG) waste rock tonnages. New operations in "north" North Lamefoot include extending an exploration drift northward into the "north" North Lamefoot ore zone and performing exploration drilling to delineate potential PAG waste rock tonnages. Both drifts would be aligned approximately parallel to and underneath the overlying 2225N drift. Operations would be conducted in accordance with the 11/30/94 and 9/20/95 RODs and the approved 12/12/96 Plan of Operations. Expansions beyond the above limits will require further plan modifications.

Permeation grouting would be performed in advance of operations to minimize water seepage and inflow, and future outflow after refilling, in accordance with the 11/30/94 ROD, Section IV.E. and as described in the approved 12/12/96 Plan of Operations, and corrective grouting will be performed to seal those faults, fractures, boreholes and other seep areas that were not grouted from 1994 to 1998 in accordance with the requirements of the ROD and Plan of Operations.

Alternative No. 2 increases the allowable PAG backfill tonnage to as much as 1 million tons of PAG waste rock, subject to the existing mitigation measures and criteria. This PAG tonnage limit will apply to waste rock excavated within the previously approved plan of operations boundaries, and for exploration, development and mining within the interim expansion areas defined in Alternative No. 2, Enlarged Interim Expansion.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

The analysis in the 7/24/98 EA for the Lamefoot Mine plan modification included the Proposed Action, the No Action alternative, and the Enlarged Interim Expansion alternative. The Proposed Action involved areas for proposed mining and other areas for initial development work prior to mining. The Agency Preferred Alternative (Alternative No. 2) includes all of the components of the Proposed Action, and additional activities that were determined to involve essentially the same impacts as the Proposed Action. A description of the alternatives can be found in the 7/24/98 EA (Section 4.0 and Appendix B).

Both Alternative No. 2 and the Proposed Action incorporate and are subject to the monitoring and mitigation measures and all other requirements from the 11/30/94 ROD as modified by the 9/20/95 ROD. EBM's Proposed Action identified mining in some areas, but only proposed initial mine development workings in other areas to prepare for future mining (under a future plan modification). Alternative No. 2 also involves mining in certain areas that EBM's Proposed Action only identified for initial mine development workings. The BLM also requires that the Conditions of Approval described later in this ROD be conducted by EBM for ongoing operations at the existing facilities and for the mine expansion.

This decision, which authorizes Alternative No. 2, Enlarged Interim Expansion, is subject to the requirements of the 11/30/94 ROD, as modified by the 9/20/95 ROD, and to the additional Conditions of Approval described herein and is consistent with the analysis in the 7/24/98 EA.

MANAGEMENT CONSIDERATIONS

The rationale for the above decision is to allow EBM to make legitimate use of the public lands in an environmentally sound manner without causing unnecessary or undue degradation. As noted in the environmental assessment, "This alternative was developed to avoid numerous repetitive proposals for small incremental expansions ..." and "is designed to provide a comprehensive evaluation of the largest individual expansion that would essentially result in the same impacts as the Proposed Action with adequate mitigation, while providing the exploration access and time needed to obtain the information to evaluate the larger future expansions that are likely to be proposed later for exploration and mining in Zone 7 and "north" North Lamefoot." Alternative No. 2 as modified and authorized by this ROD provides for the continuation and expansion of mining and ore processing in an area where mining has been identified as an appropriate land use as stated in the 1985 Spokane District Resource Management Plan, as amended.

Authorization of these operations will allow EBM to use its existing work force and its existing equipment and infrastructure to expand the Lamefoot Mine. The requirements of the 11/30/94 ROD as modified by the 9/20/95 ROD and the additional Conditions of Approval specified in this 1998 ROD will mitigate and minimize adverse environmental impacts identified in the 7/24/98 EA and address past deficiencies in predictions and mitigation. The monitoring requirements specified in this 1998 ROD will assist EBM, BLM, and others to identify, avoid, and/or mitigate, if necessary, any projected or unforeseen environmental impacts that may occur. The commitments by EBM and the COAs in this 1998 ROD will provide the protection needed. The COAs and the measures considered in the 1994 FEISS and the 11/30/94 and 9/20/95 RODs and this 1998 ROD provide opportunities for BLM to periodically refine its analysis of potential impacts during and after implementation of the plan of operations modifications. These measures allow adjustments to be made as needed to prevent unacceptable impacts, especially those impacts that may occur after mine closure.

The previous RODs included measures to mitigate known and potential impacts and to compensate for uncertainties related to site conditions and technical limitations in the scientific testing procedures and modeling. Those uncertainties still exist and the previous measures and the additional Conditions of Approval in this decision are needed to ensure that unnecessary or undue degradation will be prevented. Additional monitoring and compliance verification is needed to ensure that ROD requirements are carried out and that actual impacts fall within the scope of the environmental analysis. Some adjustments were made in monitoring station locations to accommodate new geologic information on site conditions.

CONDITIONS OF APPROVAL (COAs)

In addition to the requirements of the 11/3/094 ROD as modified by the 9/20/95 ROD, the following additional COAs are required by this decision:

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1. The ROD expressly incorporates the following mitigation measures and monitoring requirements that are included in the Environmental Assessment, as modified below.

2. **Plan Revisions**: As required by 43 CFR 3809, changes to the operation from the current Plan of Operation will require that EBM submit a revision to the current Plan of Operations for the modifications.

a) Revisions shall be limited to replacement pages and new insert sections for the existing approved Plan of Operations. The plan of operations shall be revised to incorporate descriptions of the operations and operating areas in Alternative No. 2 and all of the measures from this decision **within 90 days of the date of this decision**. In order to prevent potential unnecessary or undue degradation, failure to provide adequate revisions to the plan of operations by that date shall result in immediate suspension of authorization for activities in the expansion areas and shall require immediate cessation of any activities in the expansion areas until such time as the plan revisions are approved by BLM. Rationale: Following previous RODs, plan revisions submitted by EBM have included extensive unauthorized changes that deviated from the ROD requirements and the time period to obtain corrections for plan approval has exceeded ROD requirements by as much as one to two years or more. During those time periods, ongoing operations continued and deviated from the requirements of the RODs, creating the potential for unnecessary or undue degradation.

b) Revise the Hydrologic Monitoring Plan (HMP) in the Plan of Operations to include all of the new monitoring stations and additional functions for existing stations described in this decision. These items include adding three existing wells for monitoring water levels and water quality [complete list; LF-13, 14, and LFR-95-8 (renamed as LF-18)], adding two new monitoring wells for water level and water quality monitoring (complete list; LF-15 & 17), adding one existing monitoring well for water levels only (LF-3), adding one new piezometer installation for water levels (LF-16), adding monthly water level measurements at existing monitoring station RH-1 (Heckly well) in addition to the existing requirement for annual water quality monitoring (complete list), adding two new spring monitoring stations for water quality and flows (complete list; SP-2 & 3), adding water quality monitoring (complete list) at existing wetland stations #1, #2 and #4. Also revise HMP to include performing additional water quality sampling revisions for MSWOB-1 and 2 to correct for past deficiencies in monitoring and facilitate correlation with data from other monitoring stations. Details of these monitoring revisions are described in the COAs.

c) Water level and water quality data from all monitoring stations shall be collected, recorded and delivered to BLM in both paper format and on computer disk [i.e., spreadsheet (using Excel or Lotus) or database (MS Access)] as part of the overall monitoring program. Data from all stations shall be presented and analyzed as part of the quarterly, annual and longer-term monitoring and analysis reports submitted to BLM. Analyses shall include, but not be limited to, tables and graphs of data, statistical analyses, narrative reports and other approaches that address all of the data for all of the monitoring stations.

d) Monitoring shall include measurements and records of monthly quantities of water discharged from the mine portal, regardless of the proposed disposal location, and water quality test results for mine water taken at the point of discharge from the mine or at the internal portal sump, in accordance with the 12/12/96 Plan of Operations and the 11/30/94 ROD, Section IV.E.3.a.

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3. **Monitoring Network Revisions**: New monitoring stations (monitor wells, piezometers, springs, wetlands) shall continue to be added to the monitoring network as needed in accordance with the 11/30/94 ROD. New stations (spring gauging stations, groundwater monitor wells, piezometers) shall be added in November, 1998, in the locations illustrated in **Figure 1**. Specific locations, depths, and other parameters are to be determined based on field review and consultation with BLM. Replacement wells shall be drilled in the event that initial boreholes do not intercept the specified intervals, unless otherwise authorized by BLM. Additional monitoring functions shall be added at existing monitoring stations (groundwater monitor wells, water supply wells, wetlands) starting in November 1998.

4. **New Spring Monitoring Stations - Surface Water Quality and Flows**: Install the following two new surface water (spring) monitoring stations:

   a) **SP-2**: Surface water monitoring station using the same procedures and parameters as those used for Wolf Camp Spring. Specific location shown on Figure 1. Install the flow gauging station in November 1998, and measure water flows on a monthly basis from November 1998 through September 1999. Conduct water quality sampling and analysis for the full water quality parameter suite (complete list -12/12/96 Plan of Operations Tables H-2 and H-3) from March through September, 1999 for initial development of data for background water quality analysis. The Plan of Operations and HMP shall be revised accordingly. Continue this monitoring program and schedule as part of the long-term monitoring program until BLM provides written authorization for an adjustment to the monitoring requirements. Purpose: The primary purpose of this station is to provide a potential pathway identifier and point for detection of water quality impacts at an existing downgradient seep site. The data from the initial monitoring period will be used to determine the long-term monitoring schedule and the frequency for use of the complete list versus the short list of water quality parameters.

   b) **SP-3**: Surface water monitoring station using the same procedures and parameters as those used for Wolf Camp Spring. Specific location shown on Figure 1. Install the flow gauging station in November 1998, and measure water flows on a monthly basis from November 1998 through September 1999. Conduct water quality sampling and analysis for the full water quality parameter suite (complete list -12/12/96 Plan of Operations Tables H-2 and H-3) from March through September, 1999, for initial development of data for background water quality analysis. The Plan of Operations and HMP shall be revised accordingly. Continue this monitoring program and schedule as part of the long-term monitoring program until BLM provides written authorization for an adjustment to the monitoring requirements. Purpose: The primary purpose of this station is to provide a potential pathway identifier and point for detection of water quality impacts at an existing downgradient seep site. The data from the initial monitoring period will be used to determine the long-term monitoring schedule and the frequency for use of the complete list versus the short list of water quality parameters.

5. **Wetlands/Additional Functions - Surface Water Quality and Levels**: Conduct the following additional monitoring at existing surface water (wetland) monitoring stations:

   a) **Wetland #1**: Expand existing data collection to include monthly water quality sampling (12/12/96 Plan of Operations Tables H-1 and H-4) for the complete list of laboratory water quality parameters (Plan of Operations Tables H-2 and H-3) from at least March 1999 through September 1999 for initial development of data for background water quality analysis, except that analysis of metals at wetland stations can be limited to dissolved metals, and the Plan of Operations and HMP shall be revised accordingly. The monitoring program and schedule shall continue as part of the long term monitoring program until BLM provides written authorization for an adjustment to the monitoring requirements (sampling frequency, complete vs. short list). Purpose: The primary purpose of this station is to determine background water quality and establish this as a wetland background (upgradient) monitoring station for comparison against possible future water quality impacts at wetland stations #2 and 3.

b) **Wetland #2**: Expand existing data collection to include monthly water quality sampling (12/12/96 Plan of Operations Tables H-1 and H-4) for the complete list of laboratory water quality parameters (Plan of Operations Tables H-2 and H-3) from at least March 1999 through September 1999 for initial development of data for background water quality analysis, except that analysis of metals at wetland stations can be limited to dissolved metals, and the Plan of Operations and HMP shall be revised accordingly. The monitoring program and schedule shall continue as part of the long term monitoring program until BLM provides written authorization for an adjustment to the monitoring requirements (sampling frequency, complete vs. short list). Purpose: The primary purpose of this station is to determine downgradient background water quality for comparison against possible future water quality impacts.

c) **Wetland #4**: Expand existing data collection to include monthly water quality sampling (12/12/96 Plan of Operations Tables H-1 and H-4) for the complete list of laboratory water quality parameters (Plan of Operations Tables H-2 and H-3) from at least March 1999 through September 1999 for initial development of data for background water quality analysis, except that analysis of metals at wetland stations can be limited to dissolved metals, and the Plan of Operations and HMP shall be revised accordingly. The monitoring program and schedule shall continue as part of the long term monitoring program until BLM provides written authorization for an adjustment to the monitoring requirements (sampling frequency, complete vs. short list). Purpose: The primary purpose of this station is to determine the cause of the upward trend in conductivity at the wetland and to determine background water quality for comparison against possible future water quality impacts.

6. **Existing Monitoring Wells in the Network/Additional Functions - Ground Water Quality and Levels**: Add the following additional analysis and interpretive measures to four existing wells that are already part of the monitoring network and program.

a) Monitoring at existing monitor wells **MSWOB-1 & 2** will be substituted for well LF-15 proposed in the 7/24/98 EA. Data from MSWOB-1 & 2 shall be paired with data from existing monitor well LF-6 to give the head comparison across the fault for water gradient determinations. Monitoring at MSWOB-2 apparently ceased in March 1996 and monitoring at MSWOB-1 has not been conducted at the frequencies specified in the approved plan of operations. Monitoring at both MSWOB-1 and MSWOB-2 is required under the 9/20/95 ROD and no authorization has been granted by the BLM to cease or alter monitoring activities at either well. Monitoring shall commence immediately at both wells. Water level measurements shall be taken monthly at MSWOB-1 and MSWOB-2 as specified in the 9/20/95 ROD and the approved

Plan of Operations (12/12/96). In addition, to correct past deficiencies, water quality sampling and analysis shall be carried out monthly for the next six months at both MSWOB-1 and MSWOB-2 using the complete list of water quality parameters followed by quarterly water quality measurements for two quarters using the complete list of water quality parameters and the Plan of Operations and HMP shall be revised accordingly. Thereafter, monitoring at MSWOB-1 & 2 shall be carried out in accordance with the monitoring schedule in the Plan of Operations approved on 12/12/96. Monitoring shall continue in accordance with this program until such time as BLM makes a determination of background water quality for the monitoring network, establishes baseline levels and trigger limits for all wells in the network, and provides written authorization for any changes in monitoring at either MSWOB-1 or MSWOB-2.

Purpose: to measure groundwater levels to determine flowpaths, determine whether the Curlew Lake Fault is a barrier to groundwater flow, and to detect any water quality impacts from mine water outflow. In addition, monitoring at MSWOB-1 and 2 was required by the 9/20/95 ROD to assist in determining background water quality in order to establish baseline water quality parameters and trigger limits for the groundwater monitoring stations. Data collection and reporting has been incomplete and has delayed these determinations.

b) **LF-6**: Monthly water level data from existing monitor well **LF-6** shall be used instead of the new piezometer (LF-16) proposed in the 7/24/98 EA. Purpose: Existing data and data collected over the next twelve months shall be analyzed to determine if there is any evidence that the Curlew Lake Fault acts as a barrier to westward movement of groundwater in the project area vicinity. Water level data from LF-6 shall be compared with data from MSWOB-1 and MSWOB-2 to determine the head comparison across the Curlew Lake Fault at this location. The data on this location shall be compared with data from well LF-15 and piezometers LF-16A&B to provide a comparison of continuity of hydrogeologic conditions along the fault.

c) **RH-1 (Heckly well)**: This well is part of the existing monitoring network, and has an existing requirement for annual water quality sampling and analysis using the complete list of parameters. Monitoring shall be expanded to include monthly static water level measurements (12/12/96 Plan of Operations Tables H-1 and H-4) and the Plan of Operations and HMP shall be revised accordingly. Purpose: Information from this well will supplement water level data from LF-18 (LFR 95-8). Water levels in RH-1 reportedly fluctuate during the year and the well seasonally dries up, and this information will assist in interpreting effects on the potentiometric level of ground water.

d) **LF-3**: This well is an existing well that was deleted from the network as a water quality monitoring well in 1995 and subsequently added back into the network for water level monitoring only. Add LF-3 to the monitoring well network and long term monitoring program (12/12/96 Plan of Operations Tables H-1 and H-4), revise the Plan of Operations and HMP accordingly, and ensure that this data is included in the tables, graphs and other analyses in the monthly, quarterly, annual and longer-term reports. In addition, water levels at LF-3 are artesian. When monitoring the water levels at LF-3, the actual water elevations shall be measured (e.g., with a pressure gauge or casing extension). Note that this same measurement requirement shall also apply to all monitoring wells (or piezometers) in the network that exhibit artesian conditions (e.g., LF-3, LF-4, LF-11, MSWOB-1). Purpose: Accurate data from these locations is needed to accurately interpret the potentiometric level, gradient and direction of flow of ground water in the mine area in order to interpret the impacts of mining on groundwater outside the mine area. Data from current water monitoring has only specified "top of casing" as the elevation even when the wells may be overflowing. In other cases, the actual water elevation may be at the top of the casing, or slightly below the top of casing. Actual groundwater elevations are needed to accurately interpret the hydrogeologic characteristics of the mine area.

7. **Existing Wells To Be Added to the Network/Additional Functions - Ground Water Quality and Levels**: The following existing wells are to be used for ground water monitoring purposes and shall be fully incorporated into the monitoring program.

   a) **LF-13** is an existing monitoring well that was installed in 1996. Add this well to the monitoring well network and long term monitoring program (12/12/96 Plan of Operations Tables H-1 and H-4) and revise the Plan of Operations and HMP accordingly. Water levels shall be monitored monthly, and water quality sampling and analysis shall be conducted quarterly. The short list of laboratory water quality parameters shall be analyzed in three quarters per year, and the complete list of parameters shall be analyzed annually in the fourth quarter of each year (12/12/96 Plan of Operations Tables H-2 and H-3).

   b) **LF-14** is an existing monitoring well that was installed in 1996. Add this well to the monitoring well network and long term monitoring program (12/12/96 Plan of Operations Tables H-1 and H-4) and revise the Plan of Operations and HMP accordingly. Water levels shall be monitored monthly, and water quality sampling and analysis shall be conducted quarterly. The short list of laboratory water quality parameters shall be analyzed in three quarters per year, and the complete list of parameters shall be analyzed annually in the fourth quarter of each year (12/12/96 Plan of Operations Tables H-2 and H-3).

   c) **LF-18** (formerly named LFR95-8) is a former exploration hole that has been completed as a water supply well. Add this well to the monitoring well network and long term monitoring program (12/12/96 Plan of Operations Tables H-1 and H-4) and revise the Plan of Operations and HMP accordingly. Static water levels shall be monitored monthly, and water quality sampling shall be conducted annually using the complete list of laboratory water quality parameters (12/12/96 Plan of Operations Tables H-2 and H-3). Purpose: This well will substitute for locations shown in Figure 20 of the 7/24/98 EA as LF-15 and LF-17. The new LF-18 (formerly named LFR95-8) will monitor water level and water quality changes that may occur in the north area and to detect any water quality impacts from outflow via groundwater after the mine refills. Testing has determined that well LF-18 (formerly named LFR95-8) is in direct communication with the Wolf Camp Fault Zone, LF-14 and the northern end of the mine workings.

8. **New Monitoring Wells - Ground Water Quality and Levels**: Install new ground water monitoring stations and conduct monitoring as follows:

   a) **LF-15** (shown as LF-19 in the 7/24/98 EA): Install a water monitoring well on the east side of Curlew Lake Fault Zone paired with new piezometers LF-16A within the Curlew Lake fault zone, and LF-16B located west of and outside the western edge of the fault zone. Add this well to the monitoring well network and long term monitoring program (12/12/96 Plan of Operations Tables H-1 and H-4) and revise the Plan of Operations and HMP accordingly. The water level measurements shall be tied to piezometers LF-16A&B to determine the head comparison across the fault. The well shall be constructed with at least a 4-inch diameter (I.D.) casing and screen. LF-15 shall be completed below the potentiometric surface in the saturated bedrock within the fault block located between the Curlew Lake Fault Zone and the White Rabbit Fault. The well may be completed in the White Rabbit Fault, but bottom hole depth shall not extend below the White Rabbit Fault (estimated depth of 200 to 300 ft. with completion at about 2500 ft. elevation or lower) if this zone is saturated. Completion shall include a screened interval of at least 50 ft. in length within the water bearing bedrock. If the fractures are dry down to the fault, but the fault contains water, the well shall be completed in the fault zone.

In the event that the fractures are dry to the fault and the fault is also dry, drilling shall continue below the White Rabbit Fault to the depth where saturated conditions occur, and the well completed in the saturated zone below the fault.

Water levels shall be monitored monthly. During the first twelve months of water quality monitoring, water shall be sampled and analyzed monthly for six consecutive months and then quarterly for two quarters using the complete list of laboratory water quality parameters (12/12/96 Plan of Operations Tables H-2 and H-3). The Plan of Operations and HMP shall be revised accordingly to show this monitoring schedule (12/12/96 Plan of Operations Tables H-1 and H-4). The monitoring program and schedule shall continue quarterly using the complete list of water quality parameters until BLM provides written authorization for an adjustment to the monitoring requirements (sampling frequency, complete vs. short list). Due to the reduced frequency of sample collection after the first six month period, it is anticipated that at least 24 months of data collection will be required before making an initial background determination on this well.

Purpose: to assist in determining groundwater flowpaths, hydrogeologic characteristics of the Curlew Lake fault, whether the Curlew Lake Fault is a barrier to groundwater flow, and to detect any water quality impacts from outflow via groundwater after the mine refills. Groundwater elevations at location LF-15 will also assist in determining whether the ridge west of Wolf Camp Valley acts as a local hydrologic divide that channels groundwater outflow from the mine southwestward down Wolf Camp Valley. LF-15 and LF-16 should preferably be separated by no more than about 230 feet horizontally with locations at essentially equivalent surface elevations. However, EBM has provided new information indicating that the Curlew Lake fault is much wider and more steeply dipping than previously described and is actually a fault zone. EBM has indicated that BLM's proposed locations for monitoring would be within the fault zone. EBM's proposed location for LF-15 would place this well uphill and eastward of the 7/24/98 EA location (see EA proposed LF-19), and EBM's proposed location for LF-16B places it westward and downhill from LF-16A (see EA proposed LF-20). The projected separation between EBM's locations for LF-15 and LF-16B will be about 370 ft. horizontally with about 140 ft. or more of elevation difference between the surface locations. This great vertical and horizontal separation will complicate interpretations to distinguish a groundwater head difference due to the fault acting as a barrier from the groundwater head difference due to topography, since the groundwater elevation at LF-15 would be expected to naturally be substantially higher due simply to topographic effects. Therefore, at least three monitoring stations are needed to evaluate the groundwater conditions across the Curlew Lake Fault Zone (LF-15, LF-16A, LF16B).

b) **LF-17A** (shown as LF18 in the 7/24/98 EA) (**see general location for LF17-A, Figure 1**): Install a water monitoring well between the Curlew Lake Fault Zone and the Gravel Pit Fault, with a bottom hole completion that spans the Gravel Pit Fault. Add this well to the monitoring well network and long term monitoring program (12/12/96 Plan of Operations Tables H-1 and H-4) and revise the Plan of Operations and HMP accordingly. This is the required location for LF-17. The well at this location should be planned to intercept the Gravel Pit Fault at an elevation of about 2400 ft. to 2300 ft. and no deeper than about 2100 ft. elevation. The well shall be constructed with at least a 4-inch diameter (I.D.) casing and screen. If the hole intercepts a clearly defined fault that produces water, completion can be limited to a 50 ft. screened interval that includes the Gravel Pit Fault and fractures below the fault. If the fault is not clearly defined and has lower hydraulic conductivity and limited water production, the completion shall be a 100 ft. screened interval that includes the fault and the fractures below the fault. If the hole does not intercept a clearly defined fault producing water, drilling shall continue to the depth where saturated conditions occur and the well shall be completed with a screened interval that includes the fault and fractures below the fault so that the screened interval extends from the fault into the fractures that are saturated.

Water monitoring at LF-17A shall include measurement of water levels and water quality sampling and analysis. Water levels shall be monitored monthly. During the first twelve months of water quality monitoring, groundwater shall be sampled and water quality analyzed monthly for six consecutive months and then quarterly for two quarters using the complete list of laboratory water quality parameters (12/12/96 Plan of Operations Tables H-2 and H-3). The monitoring program and schedule shall continue using the complete list of water quality parameters until BLM provides written authorization for an adjustment to the monitoring requirements (sampling frequency, complete vs. short list). Due to the reduced frequency of sample collection after the first six month period, it is anticipated that at least 24 months of data collection will be required before making an initial background determination on this well.

Purpose: to fill a gap in the monitoring network and help determine groundwater flowpaths and gradients related to existing sulfate zonation and to detect any water quality impacts from eastward outflow from the southern end of the mine or southward outflow along the fault from the deeper northern mine expansion areas. The target elevation would be within the elevation range of the deeper mine workings. The target elevation for the LF-17A well completion may intercept a higher hydraulic conductivity portion of the Gravel Pit Fault that is a southern extension of the higher hydraulic conductivity interval of the Gravel Pit/Wolf Camp Fault intercepted by LF-14, or a similar higher hydraulic conductivity fault zone south of and outside of the healed faults surrounding the ore zone. Even if fractures with higher hydraulic conductivity are not encountered, the target elevation will enable the well to detect more dispersed groundwater movement downgradient from the mine through other fractures. LF-17A will also be placed near the edge of the pre-mining elevated groundwater sulfate zone that extended downgradient from the ore deposit to assist in detecting post-closure conditions that exceed pre-mining conditions.

c) **LF-17B**: This is a location that EBM proposes as a substitute for LF-17A, and EBM proposes to drill at this location prior to drilling a hole at LF-17A. If drilled at this location, the monitoring well shall be constructed with at least a 4-inch diameter (I.D.) casing and screen. The screened interval shall be at least 50 ft. (see 8b above) including the Gravel Pit Fault and the fractures below the fault. Monitoring of water levels and water quality shall be performed and revisions to the plan of operations and HMP shall be made as described in item 8b above. If EBM drills hole LF-17B at this proposed substitute location for LF-17A, the bottom hole location must intercept the Gravel Pit fault downdip at least 200 ft below the valley level at am elevation of 2500 ft. or deeper or well LF-17B will not be considered acceptable as a monitoring station. If the required depth of interception of the Gravel Pit Fault is not achieved in substitute hole LF-17B, EBM shall drill and install a monitor well in location LF-17A as required in 8b above. Even if the minimum depth of interception is achieved, a well at the LF-17B location may eventually have to be replaced with one at LF-17A, depending on the groundwater monitoring results.

Purpose: Note that BLM does not consider it likely that a well in location LF-17B will satisfy the BLM's proposed monitoring purposes for either location or depth of interception of the Gravel Pit Fault. The location of LF-17B has dubious limited usefulness as a monitoring location for the intended purposes because it is too shallow (i.e., above the elevation of the deeper mine workings at North Lamefoot), too close to the zone of potentially healed fractures and faults near the southern portion of the ore deposit (i.e., the Gravel Pit Fault may have lower hydraulic conductivity at this location; it may also lack a connection to the zone intercepted by LF-14 that will be part of the mining expansion), and it places wells in a cluster at one location and still leaves a large 1700-2200+ ft. gap in the monitoring network (i.e., between LF-2 & 4 to the north and LF-1, 5, 6, 7 and MSWOB 1&2 to the south).

9. **New Piezometers - Ground Water Levels**: Install a piezometer and conduct ground water level monitoring as follows:

a) **LF-16A**: Install a piezometer within the Curlew Lake Fault Zone east of the westernmost fault of the fault zone as shown in Figure 1. This piezometer is to be paired with new monitoring well LF-15 and with piezometer LF-16B and monitored as a set for the life of the operations and post-closure monitoring period, unless otherwise modified by the Authorized Officer, BLM. The piezometer shall be drilled to a depth where saturated conditions occur and shall be completed within the saturated zone. The piezometer shall be constructed with at least a 2-inch diameter (I.D.) casing and screen. Estimated depth for LF-16A is at least 150 feet. The screened interval shall be at least 50 ft. in length within the water-bearing bedrock. The completion of LF-16A is expected to penetrate into the Curlew Lake Fault Zone just east of the western edge of the fault zone. EBM shall make a head comparison with LF-16B to the west to determine if the western edge of the Curlew Lake Fault Zone acts as a barrier to westward groundwater movement. EBM shall also determine the head comparison with LF-15 across the fault zone to the east to determine if the eastern boundary of the Curlew Lake Fault Zone acts as a barrier to groundwater flow in this area. EBM shall perform monitoring at the new piezometer on a monthly basis for water levels for twelve consecutive months from the date of the first water level measurement before making the head comparison. Thereafter EBM shall continue monitoring water levels on a monthly basis as part of the long term monitoring program. The 12/12/96 Plan of Operations and HMP shall be revised accordingly.

Potential future conflicts: If a possible future State highway expansion project develops and later is determined to conflict with the location of LF-16A and/or LF-16B, a set of new piezometers shall be drilled as replacements in positions to monitor head differences across the Curlew Lake Fault Zone in locations acceptable to the BLM. In the interim, water level data shall be collected from the locations of piezometers LF-16A&B for as long as possible.

Purpose: to obtain information on the groundwater system at this location; to assist in determining groundwater flowpaths and whether the Curlew Lake Fault is a barrier to westward groundwater flow and if so, the effect on potential impacts to receptors. There is currently no evidence to substantiate EBM's conjecture that the Curlew Lake Fault may act as a barrier to westward groundwater movement. The locations of LF-16A and LF-15 should be located no more than about 230 ft. apart and at approximately equivalent surface elevations (these stations were identified as LF-19 and 20 in the 7/24/98 EA). However, new information provided by EBM indicates that the southern portion of the Curlew Lake Fault is actually a fault zone that is considerably wider and more steeply dipping than previously indicated. EBM has indicated that BLM's proposed locations for LF-15 and LF-16A are within the fault zone. EBM has proposed a new location for LF-16A (see LF-16B) downhill and about 50 ft. farther to the west to stay west of the western edge of the fault zone. EBM has also proposed a new location for LF-15 uphill and farther to the east to stay east of the eastern side of the fault zone and due to access issues. As a result, EBM's locations would place LF-15 and LF-16 an estimated distance of at least 370 ft. apart with about 140 ft. or more of elevation difference between surface locations. This great vertical and horizontal separation will complicate interpretations to distinguish a groundwater head difference due to the fault acting as a barrier from the groundwater head difference due to topography, since the groundwater elevation at LF-15 would be expected to naturally be substantially higher due simply to topographic effects. Therefore, in order to obtain more accurate data on the groundwater head across the fault zone, at least three monitoring locations are needed. LF-16A and LF-16B will be located about 50 ft. apart with surface elevation differences of 10 ft. or less, and will provide a direct head comparison across the western side of the fault zone. This will assist with interpretation of surface elevation effects between the LF-16(A&B) locations and the LF-15 location.

b) **LF-16B**: Install a second piezometer on the west side of the Curlew Lake Fault about 50 ft. west of LF-16A. This piezometer is to be paired with new monitoring well LF-15 and with piezometer LF-16A and these stations are to be monitored as a set for the life of the operations and post-closure monitoring period, unless otherwise modified by the Authorized Officer, BLM. The piezometer shall be drilled to a depth where saturated conditions occur and shall be completed within the saturated zone. The piezometer shall be constructed with at least a 2-inch diameter casing and screen. Estimated depth for LF-16B is at least 150 feet. The screened interval shall be at least 50 ft. in length within the water-bearing bedrock. The completion of LF-16B shall be west of the western edge of the Curlew Lake Fault Zone. EBM shall make a head comparison with LF-16A to the east to determine if the western edge of the Curlew Lake Fault Zone acts as a barrier to westward groundwater movement. EBM shall also determine the head comparison with LF-15 across the fault zone to the east to determine if the eastern boundary of the Curlew Lake Fault Zone acts as a barrier to groundwater flow in this area. EBM shall perform monitoring at the new piezometer on a monthly basis for water levels for twelve consecutive months from the date of first sampling before making the initial head comparison. Thereafter EBM shall continue monitoring water levels on a monthly basis as part of the long term monitoring program. The 12/12/96 Plan of Operations and HMP shall be revised accordingly.

Potential future conflicts: If a future State highway expansion project develops and later is determined to conflict with the location of LF-16A and/or LF-16B, a set of new piezometers shall be drilled in positions to monitor head differences across the Curlew Lake Fault Zone in locations acceptable to the BLM. In the interim, water level data shall be collected from the locations of LF-16A&B for as long as possible.

Purpose: to obtain information on the groundwater system at this location; to assist in determining groundwater flowpaths and whether the Curlew Lake Fault is a barrier to westward groundwater flow and if so, the effect on potential impacts to receptors. There is currently no evidence to substantiate EBM's conjecture that the Curlew Lake Fault may act as a barrier to westward groundwater movement. New information provided by EBM indicates that the Curlew Lake Fault is considerably wider than previously indicated and is actually a fault zone at this location. LF-16B is EBM's proposed location which should be located west of the fault zone. LF-16A and LF-16B will be located about 50 to 75 ft. apart with surface elevation differences of about 10 ft. or less, and will provide a direct head comparison across the western side of the fault zone to indicate if that portion of the fault zone shows any effect as a barrier. This will complicate interpretations, since the groundwater elevation at LF-15 would be expected to naturally be substantially higher simply due to topographic effects from about 140+ ft. of difference between surface elevations with LF-16A&B,. Therefore, in order to obtain more accurate data on the groundwater head across the fault zone, the three locations are needed. The data from these locations will assist with interpretation of surface elevation effects between the LF-16(A&B) locations and the LF-15 location.

10. **Map of Water Monitoring Stations**: EBM shall provide BLM with a map showing all mine water disposal points within the project area (infiltration pond), all existing surface and ground water monitoring stations (monitor wells, piezometers, springs, wetlands), as-built locations of all new surface and ground water monitoring stations (monitor wells, piezometers, springs, wetlands), and all supplemental ground water monitoring stations [include all private water supply wells with annual monitoring requirements (e.g., State Park well) - see Tables H-1 and H-4 in the 12/12/96 Plan of Operations].

11. **Revisions to Interpretive Programs**: Add the new and existing stations and additional functions for existing stations to the interpretive programs for determination of background water quality, water levels and long term monitoring using the same reporting format and parameters as the 12/12/96 Plan of Operations and HMP, except where noted by these COAs. EBM shall also add the following new interpretive programs.

    a) **Correlations Between Springs**: EBM shall develop a comparison of the data collected from sampling at the two new springs to determine whether correlations exist between the two sets of data. The monitoring program and schedule shall continue at both springs until BLM provides written authorization for an adjustment to the monitoring requirements. Purpose: If a correlation exists based on data collected through September 1999, BLM will determine if a single spring can satisfactorily meet the monitoring objectives, and whether monitoring can be discontinued at one of the springs. If such a determination is made, the second spring will be held in reserve as a potential future substitute station if flow ceases at the primary monitoring spring.

    b) **Correlations Between Springs and Wells**: EBM shall compare the data collected from the two new springs with data from deep groundwater monitoring wells LF-13, LF-14, LF-18 (formerly named LFR-95-8) and RH-1 to determine whether correlations exist between the sets of data for the

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springs and wells. Purpose: A correlation or lack of correlation will assist in identifying if the springs are independent locations for monitoring groundwater, or if they provide data that is related to monitor wells closer to the mine.

c) **Correlation Between Wetlands and Wells**: EBM shall compare the water quality data collected from wetlands sampling with the data from the shallow monitoring wells to determine whether any correlations exist between these stations. Sampling shall be synoptic, with samples preferably collected at each of the wetlands and the adjacent shallow wells on the same day. Under no circumstances shall sampling of a wetland and the adjacent well be separated by more than 48 hours. If there is any delay in sample collection beyond 48 hours, both the wetland station and the well shall be re-sampled. Purpose: To determine if there is a correlation between these surface stations and shallow groundwater.

d) **Total versus Dissolved Metals Analysis**: **After the next twelve months of data is collected** from the new and existing groundwater monitoring wells, EBM shall conduct an evaluation following Washington State Department of Ecology Ground Water Quality Implementation Guidance to determine if a correlation exists between the total and dissolved fractions of metals. If a correlation between the total and dissolved fractions can be determined, BLM will consider reducing the frequency of total metals analyses at ground water monitoring stations, subject to the concurrence of the Washington Department of Ecology, but total metals analyses will still be required periodically for compliance verification. Total metals shall continue to be analyzed for all samples until the Authorized Officer, BLM makes a determination about the suitability of any proposed changes to the monitoring program and provides a written authorization. This study shall be conducted in accordance with the requirements of the 11/30/94 ROD, Sections IV.M.3, 4 and 5. The water quality monitoring program shall continue using total and dissolved metals analyses as specified in the 12/12/96 Plan of Operations until BLM provides written authorization for an adjustment to the monitoring requirements

12. **Quality Control**: Monitoring of the short list and complete list of laboratory water quality parameters (12/12/96 Plan of Operations Table H-2 and H-3) shall include analysis of all specified parameters at all monitoring stations at the specified intervals. Failure to analyze for all elements on the short list or complete list when required and/or failure to include that data in subsequent data compilations and analysis reports shall be considered noncompliance. Similarly, failure to collect, analyze, and report other required monitoring data (mine water discharge quantities and water quality, wetlands water elevations, etc.) shall be considered noncompliance.

13. **Mine Maps and Sections**: Prepare monthly plan view maps and sections to show the "as-built" boundaries of mining zones, exploration and development workings, ramps, and other excavation areas as they are developed (this includes all previously authorized mining zones and new expansion zones), and submit those illustrations with monthly monitoring reports in conjunction with the underground seep survey documentation. Provide full monitoring data on all activities in accordance with the measures in the 12/12/96 Plan of Operations as revised by this ROD. Report all monitoring data on both paper format and on computer disk [spreadsheet (EXCEL/LOTUS)/database (MS ACCESS)] on a monthly basis.

14. **Surface Borehole Plugging Reports**: Prepare a summary report that verifies the status of grouting/borehole plugging and corrective actions taken as a follow-up to the October 8, 1998,

inventory report, and deliver the final summary report and grouting records to BLM on or before December 31, 1998. Purpose: EBM's initial October 8, 1998, surface borehole inventory list identified 26 open boreholes (excluding monitor wells) and reported that nine boreholes that were not found. A program to locate the remaining boreholes and to grout all 35 holes was verbally reported to BLM as having been completed, but the records have not been provided. Note that reclamation and borehole plugging are supposed to be performed concurrently with operations to the extent feasible, and in the future, surface boreholes should only remain open temporarily during operations if there is a demonstrable need and purpose.

15. **Financial Guarantee Cost Estimate**: **Within 6 months of the date of this decision**, EBM shall provide a cost estimate for revision of the financial guarantee to address additional measures not covered in the original 1994 financial guarantee. This cost estimate shall identify the projected cost for corrective mine-wide measures for grouting fracture zones at closure from inside the mine in the manner defined by the 11/30/94 ROD and the 12/12/96 Plan of Operations, and for post-closure grouting from the surface to seal any surface/near-surface seeps that develop after the mine refills. EBM shall subsequently increase the financial guarantee posted with the Washington Department of Ecology by an amount determined by the BLM to be adequate for such additional measures, or shall post a separate bond directly with BLM for this additional amount.

PUBLIC INVOLVEMENT

A Notice of Availability of the Environmental Assessment (EA) and a Draft Finding of No Significant Impact (FONSI) was issued to initiate a 15-day public comment period. The Notice and copies of the EA and draft FONSI were mailed in advance of the comment period to all previous parties of interest in the Lamefoot Mine with current mailing addresses. The BLM issued news releases to four television stations (Spokane), one radio station (Colville) and four newspapers (Colville, Okanogan, Republic, and Spokane) with coverage throughout eastern Washington. The Notice and copies of the EA and draft FONSI were made available for public review in nine city and county public libraries in Colville, Okanogan, Omak, Oroville, Republic, Tonasket, and Spokane, Washington. The Notice and copies of the EA and draft FONSI were posted in the public rooms at the Spokane District Office, Spokane, Washington and the Wenatchee Resource Area Office, Wenatchee, Washington. These documents were also posted on the Spokane District BLM internet website.

Comment letters were received from EBM and its consultants (total of five letters), and from the Confederated Tribes of the Colville Reservation (CCT) during the 15-day public comment period. The BLM reviewed all of the comments received and a formal response to comments is attached to this decision **(Appendix I)**.

Native American consultation for the proposed mine expansion was conducted with the Confederated Tribes of the Colville Reservation through a meeting on April 21, 1998, and copies of the EA and draft FONSI were mailed in advance of the comment period to CCT council and staff members identified on the mailing list. Additional government-to-government consultation was conducted after the comment period by telephones and letters. The CCT advised BLM in a letter dated August 31, 1998, that a satisfactory level of consultation had occurred. The general concerns expressed were that the mine might adversely impact fisheries, hunting and water resources have been addressed by BLM during subsequent communications. Issues involved questions about the lack of grouting mitigation as required by previous decisions, the potential for impacts to water quality and aquatic species, the nature of mitigation measures

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to be taken if water contamination occurs, and potential information on present and historical bull trout habitat.

In making the analyses and decision, the BLM, Spokane District, Washington consulted and coordinated with the following governments and agencies:

Confederated Tribes of the Colville Reservation, Nespelem, Washington
Ferry County Commissioners, Ferry County, Washington
Mayor, City of Republic, Republic, Washington
BLM, OR/WA State Office, Portland, Oregon
BLM, Nevada State Office, Reno, Nevada
BLM, National Applied Resources Science Center, Denver, Colorado
Environmental Protection Agency, Region 10, Seattle, Washington
Environmental Protection Agency, Headquarters, Washington, D.C.
U.S. Forest Service, Colville National Forest, Colville, Washington
U.S. Fish and Wildlife Service, Spokane, Washington
Washington State Department of Ecology, Spokane, Washington
Washington State Department of Natural Resources, Olympia, Washington
Washington State Parks and Recreation Commission, Curlew Lake, Washington
Washington State Department of Fish and Wildlife, Spokane, Washington
Ferry County Planning & Building Department, Republic, Washington

In addition, other parties consulted included:

Echo Bay Minerals Company, Republic, Washington
Echo Bay Minerals Company, Englewood, Colorado
Adrian Brown Consultants, Inc./Innovative Environmental Solutions, Denver, Colorado
Schafer & Associates, Inc., Bozeman, Montana
TRC Hydro-Geo Consultants, Inc., Lakewood, Colorado

APPEAL PROCEDURES

Operator Appeal

The operator has the right to appeal this decision to the Oregon/Washington State Director, BLM and, thereafter, to the Board of Land Appeals, Office of Hearings and Appeals, pursuant to 43 CFR 3809 Part 4 if the State Director's decision is adverse to the operator's appeal. If an appeal is taken, the operator's Notice of Appeal and Statement of Reasons and any arguments which would justify reversal or modification of the decision must be filed in writing with the BLM's Spokane District Office, Border Resource Area, 1103 N. Fancher, Spokane, Washington 99212-1275 within 30 days after receipt of this decision. This decision will remain in effect during appeal unless a written request for stay is granted pursuant to 43 CFR 4.21. A petition for a stay of this decision is required to show sufficient justification based on the standards listed below. Copies of the Notice of Appeal and Petition for a Stay must also be submitted to the Regional Solicitor at the same time as they are filed with the State Director.

Affected Public Appeal

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In accordance with federal regulations under 43 CFR 3809.4(f), any party, other than the operator, aggrieved by a decision of the authorized officer, may appeal to the Interior Board of Land Appeals (IBLA), office of Hearings and Appeals, utilizing the appeals procedures in 43 CFR 4. If an appeal is taken, a Notice of Appeal must be filed in writing with the BLM's Spokane District Office, 1103 N. Fancher, Spokane, Washington 99212-1275, within 30 days after the decision. The appellant has the burden of showing that the decision appealed is in error. The filing of an appeal shall not prevent the authorized officer's decision from remaining in effect until the appeal is heard and a decision is rendered, unless a written request for a stay is granted. A petition for a stay of this decision is required to show sufficient justification based on the standards listed below.

Standards for Obtaining a Stay

Except as otherwise provided by law or other pertinent regulations, a petition for a stay of a decision pending appeal shall show sufficient justification based on the following standards:

1. The relative harm to the parties if the stay is granted or denied.
2. The likelihood of the appellant's success on the merits.
3. The likelihood of immediate and irreparable harm if the stay is not granted.
4. Whether the public interest favors granting the stay.

Copies of the Notice of Appeal and Petition for a Stay must also be submitted to the Regional Solicitor at the same time as they are filed with the State Director.

Clifford D. Ligons

Clifford D. Ligons
Field Manager, Border Resource Area
for the Authorized Officer

Date: Nov 16, 1998

Form 1842–1
(February 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

INFORMATION ON TAKING APPEALS TO THE BOARD OF LAND APPEALS

DO NOT APPEAL UNLESS

1. This decision is adverse to you,

AND

2. You believe it is incorrect

IF YOU APPEAL, THE FOLLOWING PROCEDURES MUST BE FOLLOWED

1. NOTICE OF APPEAL . . . . Within 30 days file a *Notice of Appeal* in the office which issued this decision (see 43 CFR Secs. 4.411 and 4.413). You may state your reasons for appealing, if you desire.

2. WHERE TO FILE NOTICE OF APPEAL . . .

Bureau of Land Management
Spokane District Office, Border Resource Area
1103 N. Fancher
Spokane, WA 99212-1275

SOLICITOR ALSO COPY TO . . . .

Office of the Regional Solicitor
500 NE Multnomah, Suite 607
Portland, OR 97232

3. STATEMENT OF REASONS . . Within 30 days after filing the *Notice of Appeal*, file a complete statement of the reasons why you are appealing. This must be filed with the United States Department of the Interior. Office of the Secretary, Board of Land Appeals, 4015 Wilson Blvd., Arlington, Virginia 22203 (see 43 CFR Sec. 4.412 and 4.413). If you fully stated your reasons for appealing when filing the *Notice of Appeal*, no additional statement is necessary.

SOLICITOR ALSO COPY TO . . . .

Office of the Regional Solicitor
500 NE Multnomah, Suite 607
Portland, OR 97232

4. ADVERSE PARTIES . . . . Within 15 days after each document is filed, each adverse party named in the decision and the Regional Solicitor or Field Solicitor having jurisdiction over the State in which the appeal arose must be served with a copy of: (a) the *Notice of Appeal*, (b) the Statement of Reasons, and (c) any other documents filed (see 43 CFR Sec. 4.413). Service will be made upon the Associate Solicitor, Division of Energy and Resources, Washington, D.C. 20240, instead of the Field or Regional Solicitor when appeals are taken from decisions of the Director (WO–100).

5. PROOF OF SERVICE . . . . Within 15 days after any document is served on an adverse party, file proof of that service with the United States Department of the Interior, Office of the Secretary, Board of Land Appeals, 4015 Wilson Blvd., Arlington, Virginia 22203. This may consist of a certified or registered mail "Return Receipt Card" signed by the adverse party (see 43 CFR Sec. 4.401(c)(2)).

Unless these procedures are followed your appeal will be subject to dismissal (see 43 CFR Sec. 4.402). Be certain that all communications are identified by serial number of the case being appealed.

NOTE: *A document is not filed until it is actually received in the proper office (see 43 CFR Sec. 4.401(a))*

APPENDIX I

Lamefoot Mine
Plan of Operations Modification
WMP-130-89-019B

RESPONSES
TO
COMMENTS RECEIVED
DURING COMMENT PERIOD
ON
7/24/98 ENVIRONMENTAL ASSESSMENT
No. EA-130-08-14

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PAGE

Comment	Number	Agency Response
ECHO BAY MINERALS COMPANY KETTLE RIVER OPERATIONS 921 FISH HATCHERY ROAD REPUBLIC, WASHINGTON 99166 TELEPHONE (509) 775-3157 August 14, 1998 Via Fax and U.S. Mail Mr. Cliff Ligons Border Resource Area Manager U.S. Department of the Interior Bureau of Land Management Spokane District Office 1103 North Fancher Spokane, WA 99212-1275 Re: Lamefoot Mine Notice of Availability of Environmental Assessment and Finding of No Significant Impact Dear Mr. Ligons: Echo Bay Minerals Company ("Echo Bay"), submits these comments on the Lamefoot Mine Environmental Assessment ("EA") and Finding of No Significant Impact. We are pleased that BLM is proposing a finding of no significant impact for both the proposed action and the larger, alternative expansion. Echo Bay concurs with, and fully supports, the proposed finding of no significant impact. Echo Bay agrees that the "Impacts identified are within the scope of those analyzed and portrayed in the 1994 Lamefoot Mine Final Environmental Impact Statement Supplement as stated in your notice of July 30, 1998. Echo Bay also agrees with your conclusion that "mitigated development will not cause unnecessary or undue impacts and will involve impacts similar in intensity and effect to those previously predicted." Id. However, Echo Bay and its consultants believe that the EA, upon which the finding of no significant impact is based, greatly exaggerates the potential adverse environmental impacts which are associated with the proposed expanded mining activities. We do not believe that the EA needs to be rewritten and reissued, because it does support the proposed finding of no significant impact. Nonetheless, we believe it is imperative for BLM decision-makers to understand that the EA does fundamentally overstate the impacts associated with the proposed mining activities. Accordingly, we submit the enclosed specific comments of Echo Bay on the EA, which are supported by extensive scientific studies that have been conducted by highly qualified consultants in the fields of geochemistry and	1-1	1-1 See EASection 2.0, p.4. BLM has noted that the opinions of EBM and its consultants differ from BLM regarding interpretation of the data and analyses.

Comment	Number	Agency Response
Mr. Cliff Ligons August 14, 1998 Page 2 hydrogeology over the past five years. The preparation of these specific comments has been coordinated by Echo Bay's Superintendent of Environmental Affairs, Steve McIntosh, and they have been fully reviewed by the team of Echo Bay mining engineers, geologists and consultants who have been working intensively on this project for years. The primary Echo Bay comments are supplemented by the enclosed individual comments of: (1) Dr. William Schafer and Mr. Ed Spotts of Schafer & Associates, addressing geochemistry issues; (2) Mr. Adrian Brown of Adrian Brown Consultants, addressing hydrogeologic issues; (3) Mr. Joe Frank and Mr. Vladimar Straskraba of Hydro-Geo Consultants, addressing hydrogeology and grouting issues; and (4) Dr. John Woodward of EnviroData Solutions, addressing the surface water and groundwater monitoring issues.		
For the Record of Decision, we caution the BLM not to rely on unsupported statements about environmental risks in the EA to determine appropriate mitigation conditions for the plan of operations. Echo Bay has expended enormous financial and personnel resources to conduct extensive studies on geochemical and hydrogeologic issues of concern to BLM in connection with this project since 1994. These studies, which BLM possesses, cumulatively present overwhelming evidence to support your proposed finding of no significant impact. Nonetheless, many aspects of BLM's EA fall to acknowledge and conflict with much of the data collected for and many of the central findings of the scientific studies which have been conducted.	1-2	1-2: See response 1-1. BLM has participated in and reviewed the revised technical studies since 1996 and has given appropriate consideration to the full scope of data and analyses. "The purpose of this environmental assessment (EA) in 1998 is to determine whether existing actions and proposed modifications may involve cumulatively significant unmitigated impacts not addressed in the FEISS that require analysis in a new supplemental impact statement." (See Section 1.0, p.1). In preparing the environmental assessment,, BLM must make its own evaluation of the environmental issues and any technical supporting documents prepared by EBM and its consultants [40 CFR § 1506.5(b)]. Note that BLM's proposed finding was that there would be no unmitigated significant impact.
We fear that the overstatements of potential adverse environmental impacts which are found in the EA may be used as justification for the imposition of more onerous mitigation measures upon Echo Bay's remaining limited mining activities at the Lamefoot Mine. We urge you to consider these comments as you adopt the Record of Decision and final mitigation conditions. Echo Bay representatives will be pleased to meet with you and other appropriate BLM staff to discuss these issues further at your earliest convenience.	1-3	1-3: See response 1-1.
Finally, as set forth in my letter to Joe Busing, dated July 16, 1998, time is of the essence in this project. Echo Bay has an absolutely critical need for BLM's prompt approval of its mining expansion plan of operations. Echo Bay looks forward to working cooperatively with you to bring this process to a close rapidly. Sincerely, Marv Walker Mine General Manager		

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SPECIFIC COMMENTS OF ECHO BAY MINERALS COMPANY ON THE JULY 1998 BLM ENVIRONMENT ASSESSMENT FOR THE LAMEFOOT MINE I. ACID ROCK DRAINAGE ("ARD") ISSUES A. The BLM Has Overestimated The Amount Of Backfilled Potentially Acid Generating Waste Rock. Page 1, last paragraph, item 1, and page 2: The numbers for the waste rock that are presented are incorrect and greatly inflated. The 1998 Environmental Assessment ("EA') claims that the September 20, 1995 Record of Decision ("ROD")' was based on an analysis that projected that "only about 164,300 tons" of potentially acid generating ("PAG") waste rock would be produced and used as backfill for the life of the Lamefoot Mine. In fact, the 1995 ROD and associated EA did not even mention the quoted figure of 164,300 tons which the Bureau of Land Management ("BLM") now suggests was a strict limit in that ROD. The 1995 EA stated merely that "[a]bout 9% of the total backfill is waste rock that has acid generating potential." 1995 EA at 7 (emphasis added). This 9%figure was obviously merely a rough estimate of what geologic conditions were expected, not a limit on future operations.	1-4	1-4: EBM provided supplemental information on projected backfill composition to BLM for preparation of the 9/20/95 EA. EBM submitted a document to BLM dated September 7, 1995, titled "Clarification of Lamefoot Mine Supplemental Plan of Operations" following a meeting with BLM on September 6, 1995. Figure 3 projected a total of 611,090 tons of waste rock, of which 26.8 percent would be altered limestone and clastic rock (i.e., PAG rock types). Figuree 4 estimated backfill tonnages as follows: clastic plus altered limestone = 164,291 tons limestone plus intrusive = 345,709 tons Corl & Torboy = 1,350,000 tons Total Tons = 1,860,000 tons The clastic plus limestone tonnage equates to 8.8% of the total backfill tons. This percentage was rounded to "about 9%" in the 9/20/95 EA.
In the 1998 EA, BLM claims that "by the end of May 1998, the existing backfill already totaled about 442,600 tons of PAG waste rock." 1998 EA at 2. This number is far too high and provides a distorted representation of the ARD risk. Of the more than one million tons of waste rock that were used as backfill in the Lamefoot Mine, more than 99% of the fill is classified by actual test data as neutralizing(more than 3 times the neutralization potential to acid producing potential), leaving less than 1% as PAG. From May 1, 1995 to June 26, 1998 a total of 1,276,397 tons of backfill was placed in the mine. Thus, the amount of PAG waste rock backfilled in place through June 26, 1998 is less than 12,000 tons. The weighted average of the ratio of neutralization potential to acid-generating potential ("NP/AP") in the backfilled waste rock was 7.6 (more than twice the 3:1 value that is required). Only 2 samples from a total of 400 did not meet the conservative standard of 3: 1. All BLM decisions and environmental analyses, as well as studies and memoranda sent to BLM, which are cited herein are incorporated by reference into these comments and should be considered a part of the administrative record for this 1998 EA and the subsequent ROD.	1-5	1-5: See EA Section 1.0 for a discussion of PAG tonnages. As of the end of the September 1998 reporting period, total existing tonnage of PAG rock in the backfill has risen to 462,337 tons. Blending PAG rock types with NAG rock types meet the ROD blending criteria (i.e. >20 TCaCO3/kT and >3:1 ANP:AGP for every 5000 ton sample lot) does nothing to change the characteristics of each rock type. EBM's statement is a misrepresentation of geochemical testing for acid generation potential. The potential for acid generation is based on the individual rock types. Backfill deliberately mixes PAG rock with NAG rock as a measure to control effects of acid generation. Static tests of backfill are performed on composite samples to determine whether adequate quantities of neutralizing rock have been added to compensate for the acidity that may be derived from the PAG rock types (clastic plus altered limestone). The averages for these widely disparate positive and negative values are not representative of the acid generating character of the rocks and emphasis on those averages is seriously misleading. The samples tested for backfill are composite samples of PAG and NAG rock with widely disparate individual values. Averaging those results does not characterize the acid generating potential of the components of the mixture. Clastic rock blended with limestone is still clastic rock and has the potential to generate acidity within the mixture. The purpose of the neutralizing rock is to counteract that acidity as close to the source as possible, but it does not change the character of the PAG rock or prevent acid-generating reactions. High ratios of neutralizing rock in the blended mixture do not preclude the occurrence of ARD, but may or may not act to neutralize and reduce the effects of ARD. Morin and Hutt, 1997, note, "Averaging data for a rock unit or minesite component gives the impression that it behaves as one homogeneous unit, which is rarely true". The proportions of the backfill are intended to compensate for all sources of acidity within the mine, including the crown pillar and wall rock. Calculating the weighted average ANP/AGP ratio of the backfill alone fails to consider the potential acid generating capacity of the crown pillar and wall rock which constitute the major quantity of PAG rock. Therefore, the approach suggested by EBM substantially overstates the weighted average value for the mine. Numerous samples have failed to meet the 11/30/94 & 9/20/95 ROD blending criteria. Out of 400 samples through June 1998, 3 samples had an NNP less than 20 TCaCO3/kT and 20 samples had an ANP:AGP ratio less than 3:1. To the extent feasible, these results were evaluated in accordance with the 12/12/96 ROD to adjust for variances in sample size. However, 34 samples exceed 5000 tons by more than one truckload (15-20 tons); of those, 21 samples exceeded 5000 tons by more than 100 tons. Geochemical test results for some of these samples may numerically meet the blending criteria, but the results are not valid for a 5000 ton sample lot because a 5000 ton sample lot may not have been able to meet the blending criteria without the excess neutralizing material that was added by the extra tonnage. Also, four of the samples failed the criteria because they exceeded 5000 tons and had an ANP:AGP ratio less than 3:1.

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Echo Bay is proud of the environmentally protective conditions which exist at the Lamefoot Mine. BLM should be as well. This mine should be considered a showcase. Yet, the discussion of the waste rock presented in this 1998 EA presents an eroneous and very negative perspective that creates the totally unwarranted impression of a significant risk that the mine will develop ARD. The PAG volumes presented in this 1998 EA are based on gross estimates general rock type. These values are the product of estimated waste rock percentages that are then assigned to a pre-determined category, i.e., either PAG or non-PAG. As an example, the mine geologists might predict that mining will encounter roughly 1,000 tons of clastics and 1,000 tons of altered limestone with the next mine advance. Using the general categories which have been assigned to these rock types, these values would be deemed 2,000 tons of PAG rock. However, the lab test data would typically show that a large percentage of both the clastics and the altered limestone would actually have NP/AP values greater than the 3:1 standard.	1-6	1-6: Since December 1994, EBM has sought to eliminate mitigation measures that were developed by EBM and Woodward Clyde Consultants as part of the FEISS process and committed to by EBM as part of their proposed action. EBM has delayed implementation of some measures and has not carried out others as required in the RODs. These actions are less than would be expected for a "showcase" operation. Also, this is an incomplete and inaccurate description of the sampling process. The predictive procedures described are used by EBM as a preliminary means to identify approximate percentages of different waste rock types that will be produced from scheduled mining areas. This information assists EBM to schedule backfill proportions. BLM has witnessed the sample collection quality control procedures that are used by EBM prior to sending samples to the laboratory for analysis. Since backfill is placed before receiving laboratory results, EBM uses a preliminary visual estimate of backfill blending as a check and balance to attempt to meet the blending criteria. After crushing and splitting the samples, EBM's sampling staff examines the samples and makes a visual estimate of the percentages of each rock type. These percentages are recorded on backfill tracking sheets and multiplied by the mean geochemical values for each rock type and the estimated tons of backfill to determine the approximate weighted average ANP, AGP and net NP. From this, EBM calculates an estimated Net NP and ANP/AGP. The results of these estimates are later compared with the results of the actual laboratory tests on each sample, and this information is provided to BLM. Geochemical values based on visual estimates may vary considerably from laboratory testing, with both higher and lower estimated values, but the results have been comparable enough to indicate that the PAG rock tonnages are reasonably accurate.
Based on these lab test data, the volume of PAG backfill placed in the mine is far less than the estimates that were previously reviewed by the BLM in the 1994 Lamefoot Mine Final Environmental Impact Statement Supplement ("FEISS") and ROD, and the 1995 EA. Because the lab-determined values have been produced at the direction of the BLM and, most importantly, because these numbers represent hard data collected from the mine rock, they are the most reliable indicators of the negligible ARD potential at this site.	1-7	1-7: See EA Table 1 for PAG backfill tonnages from the FEISS, 9/20/95 EA, and monitoring reports as of June 1998. See Response 1-5; PAG rock in backfill increased to about 462,337 tons as of the end of September 1998.
B. The Cement Used In Backfilling Further Minimizes The Already Low Risk of ARD.		
Page 3, second paragraph, line 6: Though cement is discussed as a positive benefit chemically and physically in the 1998 EA, the BLM does not acknowledge the significant chemical contributions of this material in this 1998 EA and in the monthly reports that provide a summary of the backfill chemistry. The chemical contributions of the cement are significant and very positive and should have been included in the calculations that are presented in the 1998 EA to present a realistic portrayal of the negligible ARD risk at the Lamefoot Mine.	1-8	1-8: BLM directions to EBM in a meeting on March 26, 1997 were that the geochemistry model was to include to include all components of the backfill (see 5/27/97 BLM fax to EBM, Geochemistry models, item 4, "... since the projected amount of cemented fill has increased substantially, the updated NAG rock tonnage estimate will identify the new estimated total for tons of cement projected for the life of the mine."). The updated 1997/98 models include revised cement contributions of "5 wt. %" (May 1998 Impact Evaluation report, Appendix C-3, Table 3.1, footnote 6 in EA Section 8.0, document 29). The models and other studies (see EA Section 8.0 documents 48 and 49) were evaluated and the effects of cement were discussed in the 1998 EA (e.g., see 1998 EA Section 6.4, p. 35). In 1995, BLM and the Bureau of Mines evaluated effects of cemented fill (e.g., see 1998 EA Section 8.0 document 48 and 9/20/95 EA p. 12). The 1994 FEISS also evaluated the contribution of cement (e.g., see FEISS Figure 3.3-3 and Section 4.3.2).
We are pleased that at least the statement is made that cement acts to "control oxidation of acid producing sulfide minerals and add more neutralizing material directly in contact with those minerals."1998 EA at 3. The U.S. Bureau of Mines produced a report titled "Evaluation of Proposed Changes in Backfill Plan, Lamefoot Mine, WA" by Russell L. Levens, dated August 31, 1995. Following an evaluation of the contributions of cement the author states: "Cement will provide a source of material for buffering that is not readily leached and may provide some beneficial physical characteristics to the potentially acid-producing waste. Cemented pillars will probably contain the smallest pore spaces of any backfill materials, resulting in higher water saturations due to capillary attraction."	1-9	1-9: See response 1-8. The U.S. Bureau of Mines report was prepared for BLM and is supporting document 48 (see EA Section 8.0). This was one of the reasons for 9/20/95 ROD condition of approval number 2, "... Ensure that the majority (50% or more) of the potentially acid-generating waste rock is placed in the cemented pillars."

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Though the BLM endorses the positive impacts of cement, the waste characterization reports that are submitted to the BLM on a monthly basis, and the figures that are presented by the BLM in the 1998 EA regarding the PAG values inside the mine, do not include (at BLM's direction) quantification of the cement that is added during mining. This additional volume of cement is very significant and the additional mitigative effects of the cement should be considered in the characterizations of the in-mine chemistry. None of the statements regarding the PAG values that are contained in the mine reflects the additional neutralization potential added by cement. Thus, the PAG values stated in the 1998 EA are all significantly overstated.	1-10	1-10: This statement is not accurate. The analyses by BLM and EBM's consultants have considered the contribution of cement throughout the review process from the FEISS through 1998. See Response 1-8.
C. Since 1995, Extensive Studies Have Established That There Is No Material ARD Risk At The Lamefoot Mine. Page 7, third full paragraph, sentence 2: According to this statement, 'the environmental analysis issue is not the specific tonnages but rather the potential for and magnitude for impacts that may result. " We agree, and given the abundance of ARD analyses which have been conducted at this site, it can be concluded that the potential for adverse impacts from ARD of any measurable magnitude is nonexistent. Based on the large volume of waste rock testing that has been conducted on the waste rock at Lamefoot, the geochemical experts have stated quite emphatically that the waste rock at Lamefoot is predominantly neutralizing and notably resistant to ARD production, as stated in the July 1995 "Impact Evaluation for Full Development of the Lamefoot Mine," authored by Adrian Brown Consultants, Hydro-Geo Consultants and Schafer & Associates (at 29): The geochemical characteristics of the major lithologies in the Lamefoot Project area are favorable for prevention of acid rock drainage, and for the neutralization of any ARD which might form elsewhere. All lithologies contain a significant amount of acid neutralizing potential which prevents the rapid formation of acid conditions. Additionally, pyrite in Lamefoot samples was found to be in a form which was only slowly reactive. These conclusions based on laboratory tests, are confirmed by field test results in both new and historic mine workings. Furthermore, should ARD occur in localized areas, the bulk of the rock in areas adjoining the mine, especially in the direction of ground water flow, contain a large excess of neutralizing capacity which will provide secondary neutralization and effective control of most mobilized metals. Finally, there also appears to be a considerable attenuation capacity for most metal species	1-11	1-11: The quote cited is not accurate. The last sentence of the quote is actually, "Finally. there also appears to be a considerable attenuation capacity for the principal potentially mobilized metal species in materials along the groundwater flow path." BLM generally agrees that there is sufficient neutralizing potential to neutralize acidity under a variety of possible circumstances, as reflected in the 1997/98 geochemical modeling. There is no rock mass that is "resistant" to ARD if the materials in question have sulfide composition in enough abundance to allow weathering to occur and sulfides to oxidize. In such conditions exist, the potential is always there for ARD to occur. Neutralization potential does not prevent acid generation. Evangelou, 1995, notes that, "there is also evidence which suggest that at high pH carbonate may in fact enhance pyrite oxidation (Hood, 1991, Evangelou et al., 1985; Stiller et al., 1985) but carbonate-enhanced pyrite oxidation rates are not expected to approach those commonly observed at low pH (e.g., pH 2.7)(Jaynes et al., 1984, Jaynes, 1991 and references therein)". EBM's consultants' 1995 studies indicated that the pre-mining and post-closure situation involves neutralized acid generation, not the absence of acid generation. A low pH is not the only issue with acid generation. Neutralized acid generation has effects on water quality, as evidenced by their 1995 Impact Evaluation prediction for refill waters (Table 6-1) and their 1998 Impact Evaluation report (Table 3.3). The July 1995 "Impact Evaluation" report understates many of the potential sources of acidity and the test results. Both the 1995 "Impact Evaluation" and the associated June 1995 "2750 Level Hydrology and Hydrogeochemistry Final Report" contain numerous contradictory statements, test data and study results. For instance, the testing of PAG rock in historic mine workings showed that pH declines over the long term, particularly when sulfide material is directly exposed to moisture. Detailed wall rock sampling and core analysis by EBM in August 1994 identified that the final wall exposures at closure will range up to about 10% sulfur content on the east wall and up to about 20% sulfur content on the west wall, with sulfide minerals well distributed over all areas. This widespread distribution of sulfides was one of the issues that made it unfeasible for BLM to authorize the proposed action in the FEISS in its original form and required development of the selected alternative in the FEISS. The June 1995 report found that pyrite was low to moderate sulfide oxidation rates. Also much of the 1995 report conclusions were based on a prediction that the mine workings will completely flood, a situation that appears unlikely.

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in materials along the groundwater flow path. [Emphasis added.] Page 7, paragraph five, last sentence: "underestimates of PAG tonnage persist. . . . "Refer to the comments in Section I.A above. Page 7a: This table improperly presents PAG values that are derived from gross estimates of rock type and the categories assigned to each rock type, rather than the lab test data that have been collected on over 400 samples of waste rock. See Section I.A above.	1-12	1-12: Characterization of PAG rock type was determined by extensive testing in the FEISS. Those test results were corroborated by the June 1995 "2750 Level Hydrology and Hydrogeochemistry Final Report", see p. 4-9 which states, "The ABA data from this data set (Table 4-2 and Figure 4-3) corroborates the data presented in the EISS .." and "there does not appear to be a notable change in the geochemical nature of the clastic rocks at depth regarding their potential for acid formation." See Response 1-5 regarding test results on backfill.
D. Further Studies From 1995 To 1998 Consistently Have Demonstrated That There Is No Real Risk of ARD At The Lamefoot Mine.		
The 1998 EA suggests that the mine has shown resistance to production of ARD, but that eventually the mine will produce ARD and the mine water will degrade significantly due to this ARD generation. It is suggested that ARD generation is a certainty, but that it may take a slightly longer time to develop than might otherwise be expected. The consultants (Schafer & Associates; Adrian Brown Consultants; and Hydro-Geo Consultants) have made it clear in at least three major studies - (1) the July 1995 "Impact Evaluation for Full Development of the Lamefoot Mine;" (2) the May 1997 "Revised Impact Evaluation for the Proposed Expansion of the Lamefoot Mine;" and (3) the May 1998 "Impact Evaluation for the Proposed Interim Expansion" - that the mine has an abundance of neutralizing material to counteract any sulfide oxidation that might occur, and that the development of ARD is not a real risk at this mine.	1-13	1-13: The only characterization of rock types and potential for acid generation took place in 1995 (see item 1-12; also the July 1995 Impact Evaluation for Full Development of the Lamefoot Mine was a part of that study). The 1997 and 1998 reports mentioned by EBM are modeling studies based on the characterization work done in 1995. At the direction of BLM, these modeling studies were to use all the test data from 1995, including data omitted from the 1995 studies that indicated less favorable conditions. The 1997/1998 modeling was also to use current data from monitoring reports showing the complete current backfill composition, including cement, and the revised projections of PAG waste rock quantity through end of mine life. The consultants identified that ARD would require a long lag time and that ARD would be neutralized. That is not the same as the absence of all pyrite oxidation and ARD neutralization and the associated byproducts.
In May and July of 1995 the expert consultants submitted extensive test results analyzing the ARD generation potential of the rock at the Lamefoot Mine, summarized in the July 1995 report on the"Impact Evaluation for Full Development of the Lamefoot Mine." The report summarized the results of extensive laboratory testing of ARD potential including humidity cell tests, which were run for 20 to 25 weeks. In particular, the humidity cell tests results "were that no sample had gone acid by the end of the test period ... and that only slow sulfide oxidation was observed in any sample during the test period. No significant release of metal constituents was observed from any sample. Id. at 18(emphasis added). The humidity cell tests that were evaluated under BLM direction showed that, even under conditions most favorable to the development of ARD, the waste rock from the mine was remarkably resistant to producing ARD. Most of the humidity cells were composed of mine rock that is most favorable to the development of ARD; the cells were injected with bacteria that catalyze the sulfide reaction. and a number of the cells were run for a longer period of time than is normal. Even under these conditions none of the humidity cells produced ARD. 4	1-14	1-14: Testing in 1995 was conducted to obtain approval to mine the zone below the 2750 elevation for areas that were originally proposed in the FEISS. The only thing shown by testing is that the rock materials have neutralizing potential to some degree, but this is not representative of all rock tested. Humidity cells in 1995 were run for routine, but relatively short periods of 20-25 weeks. At the end of that time period, a number of the cells exhibited continuing pyrite oxidation that was project to continue for a considerable time. The absence of net acid production from the humidity cells is not significant the cells were not all run until completion. Under normal circumstances these cells may have been run to completion, and it is not uncommon to run humidity cells for extended time periods that may range up to 4 years. However, EBM noted potential conflicts with mine scheduling for the originally proposed deeper zone if BLM's environmental review would be delayed beyond September 1995. Since it was apparent from the pyrite oxidation rates and carbonate content that these humidity cells would eventually generate acidity, but only after a long lag time, BLM authorized premature discontinuance of the tests and extrapolated from the 20-25 week test data. White (1992) describes an evaluation of results of short-term humdity cell tests at another site, stating, "Although static testing acid-base accounting classified all three samples as acid producers, only two of the three samples subjected to accelerated-weathering (humidity-cell) tests have produced acid effluent. ... Although the effluent from the third sample (1-D) has ranged from alkaline to neutral throughout 51 weeks of humidity-cell testing, combined static and kinetic test results indicate that is has as much as 39 years of acid-producing potential, but less than 3 years of neutralizing potential. On the basis of monitored calcium and magnesium release rates compared with sulfate release rates, onset of acid production from sample 1-D is predicted to occur after 110 to 130 weeks. If kinetic testing of sample 1-D had been terminated at 20 weeks, as has been common practice, the sample could have been mis-classified as non-acid producing." Short-term kinetic tests are not definitive. Also, the June 1995 "2750 Level" report (p. 4-13), noted, "Thus, development of acidic conditions in the clastic rocks would likely be delayed for a considerable length of time until the bulk of available neutralization capacity was expended. ... It is therefore very unlikely that acidic conditions would develop and predominate on a mine wide scale." (emphasis added). Delayed onset of ARD and neutralization of that acidity are not the same as not having acid generation. Appendix C described a 60-80 year old adit noting, "The water chemistry ... is indicative of areas which have formed or accumulated products of sulfide oxidation but the bulk of the acidity has been neutralized. Again, this is consistent with the humidity cell tests which show that there is usually sufficient neutralization potential in the host rocks to provide for neutralization of acid as if forms." (emphasis added).

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These results indicate that the mine is notably benign and that extreme mitigation measures are not appropriate. As the July 1995 report stated, the "general conclusion from these observations is that the presence of a large reserve of available neutralization potential controls the final rinsate water chemistry, and prevents acid generation in the lithologies tested." Id. The final conclusions of the July 1995 report were especially favorable and strong: The ... mine is not expected to generate any significant amount of acid, and the contained neutralizing capacity of the actual mine system will be considerably greater than the neutralizing capacity provided by the backfill, as the downgradient walls of the mine are excavated in limestone, with substantial neutralizing capacity. Accordingly, there is a large margin of protection against un-neutralized acid ever being present in the mine void, or moving through the groundwater system .... Thus it is concluded that there is a great excess of neutralization available to control ARD (although little ARD is expected), and that no acid will remain in the mine or escape from the mine void. Id. at 41-42 (emphasis added).	1-15	1-15: The 1995 Impact Evaluation conclusions were not fully supported by the test data, and tended to understate the negative findings and overstate the favorable results. There were also numerous inconsistencies in the methods that led to results that appear to be more favorable. Therefore, the BLM did not fully accept the results of the 1995 studies, but independently concluded that there was sufficient data to support a finding of no significant impact with mitigation. As noted in Response 1-10, absence of a low pH alone does not prevent degradation of water quality. Although the mitigation measures are expected to maintain a near-neutral pH, the prediction for the mine is neutralized acid rock drainage which does have an effect on water quality. The consultants' 1995 report identified the potential reduction of neutralization capacity from carbonate coating (passivation) but did not consider those reductions in their other geochemical analyses. As a result, their statements about a "great excess of neutralization" did not address the potentially reduced available neutralization capacity within the mine. The 1995 report also relied on attenuation outside the mine as a control measure. Among other reasons, this led to updating of the 1995 models in 1997/98 using substantially revised input parameters, assumptions, modeling approaches and sensitivity analyses. The resulting model indicates there is adequate available neutralization capacity for the uncertainties involved, but not a great excess. (see Response 1-21).
These strong conclusions were repeated by the consultants in a May 1997 report that reflected further extensive evaluations to satisfy any remaining BLM concerns. In the May 1997 report on the "Revised Impact Evaluation for the Proposed Expansion of the Lamefoot Mine," the conclusions were stated in especially firm language, again, as follows: Results of geochemical modeling indicate there is a large supply of excess neutralization potential in the backfill to neutralize both influent acidity as well as acidity produced as the result of oxidation of pyrite in the backfill. As a result, mine water is predicted to be of a neutral to alkaline pH. The precipitation of ferrihydrite during mine filling and neutral pH values of the mine water are predicted to maintain low concentrations of copper and zinc in the mine water. These findings are similar to those of the original impact analysis.	1-16	1-16: See Response 1-10. Mine refill water chemistry is somewhat similar between 1995 and 1997/98 models, particularly with regard to sulfate and manganese, as noted in EA Table 6 and the 1998 Impact Evaluation report Table 3.3.
Finally, the adjacent bedrock is expected to attenuate metals in the mine water over a very short 5	1-17	1-17: The 1995 Impact Evaluation projected maximum transport distances for copper and zinc of 1300 ft. and 1900 ft., respectively. By comparison, the 1998 Impact Evaluation projected maximum transport distances for copper and zinc of 65 ft. and 1756 ft., respectively. The 1998 Impact Evaluation report, Table 3.4, and EA Table 7 note that sulfate and manganese are not entirely attenuated along the flowpath to Curlew Lake. The 1998 Impact Evaluation notes, "For example, all results (pore volumes 1 through 10) represent water quality where groundwater and crown pillar inflow are characterized by neutralized ARD (Table 2.3). Through time, the mine void water chemistry is actually expected to be similar to pre-mine background water chemistry in the mine area as upgradient groundwater from the east flows into and through the mine. This would have a particular effect on sulfate and manganese (for which there are secondary standards) concentrations in Table 3.3 because they to not undergo attentuation in the model and therefore directly reflect the higher values of the conservative inflow chemistry." (emphasis added). However, BLM notes that the time period for pore volumes may be measured in decades, as identified in the 1998 EA (p.36). The 1998 Impact Evaluation goes on to state, " Additionally, the modeling does not account for any effects of dilution that can occur as groundwater migrates from the mine void west, into the adjacent bedrock, potentially lowering constituent concentrations." (emphasis added). However, although the report relies on the presumption that dilution

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distance along the flow path to Wolfe Camp Creek, resulting in negligible impacts to water quality adjacent to the mine area as a result of the proposed expansion of the Lamefoot Mine. These conclusions corroborate the findings of the original impact evaluation. Id. at 10 (emphasis added).	1-17	1-17 (contd): will lower the concentrations, it does not calculate or estimate the degree of effectiveness of dilution or project the actual impacts outside the project area. The 1997/98 models evaluated attenuation for dispersed release of mine water through a fractured zone 280 ft. long, 50 ft. high, and 10 ft. wide (1998 Impact Evaluation in June 1998 hydology section replacement, p. 15, by Adrian Brown Consultants, dated 5/20/98). The models did not address direct release of mine water through boreholes with essentially no attenuation prior to reaching alluvium.
The May 1998 report on the "Impact Evaluation for the Proposed Interim Expansion for the Lamefoot Mine," which utilized extreme worst case assumptions, further confirmed the prior conclusions. It concluded that "[g]eochemical modeling indicates that post-filling mine water will have a slightly alkaline pH (7.4) and low metal concentrations, which will be further attenuated as water flows through adjacent fault material and alluvium." Id. at 23. In summary, the 1998 "findings corroborate previous modeling efforts and indicate that there will be no appreciable impacts to water resources adjacent to the Lamefoot Mine as a result of the proposed expansion."Id. (emphasis added).	1-18	1-18: BLM does not entirely agree with the 1998 Impact Evaluation conclusions. See discussion of sulfate and manganese in EA Tables 6, 7, 8, 10, and p. 29-33, and 40. Modeling results for 1998 are similar to 1995, but 1998 information indicates a greater potential for direct release to the surface/near-surface. Even water with pre-mining concentrations of sulfate and manganese would cause an impact if released directly to the alluvium in Wolf Camp valley.
The static testing continues to show that the vast majority of the waste rock (more than 99%) has an NP/AP value of 3:1 or greater (though 1:1 values are neutralizing, 3:1 values have 3 times the alkalinity required to neutralize one part of acid). The waste management at Lamefoot should reflect the results from the extensive humidity cell tests that are available. The second geochemical standard for waste rock that is set forth in the ROD is a minimum net neutralization potential("NNP") value of 20.0. As of May 1998, the average NNP value for all waste rock in the mine was 415.1.	1-19	1-19: That is an inaccurate summary of the static test data and an extremely misleading description of the backfill criteria and geochemical values in the mine. Ration values of 1:1 are not inherently neutralizing under actual field conditions (see Responses 1-5, 1-6, 1-29). Morin, 1990, notes that "an additional complication arises in the assumption that 1 part of $CaCO_3$ represents 2 parts of acidity. ... a ratio between 2:1 and 1:1 may be more appropriate so that conversion factors... would have to be multiplied by a value between 1 and 2, increasing the Acid Potential." PAG and NAG rocks in the blended backfill mixture range from high acid generating capacity to high neutralizing capacity. Emphasizing the average value of the mixture gives a misleading perspective of the actual character of the rock. PAG rocks have minimum values as low as -477.9 NNP & 0.47:1 NP:AGP altered limestone, -249.5 NNP & 0:1 NP:AGP clastic, -111.3 NNP & 0.11:1 intrusives. At the other extreme neutralizing rocks have maximum values of 726.4 NNP & 1404.8:1 NP:AGP altered limestone, 384.3 NNP & 36.16:1 NP:AGP, 494.7 NNP & 1584:1 NP:AGP intrusives, 1285 NNP & 3360:1 NP:AGP limestone, and 903 NNP cement. Composites of such extreme values cannot be accurately represented by averages (See Response 1-5). The consultants have made both statements, i.e., that the mine may produce acidity but that it will be neutralized. That is technically considered to be neutralized ARD.
Page 11, Section 4.3, second paragraph: The 1998 EA should have considered the model test results that were generated under the close supervision of the BLM and produced by the BLM approved consultants (Dr. Schaefer, et al.). Those tests show the mine has enough neutralization potential to accommodate up to 2 million tons of PAG material and still meet ROD requirements for NP/AP and NNP. The expert consultants have not stated that the mine will eventually produce ARD, but that the mine will remain neutral.	1-20	1-20: The ROD criteria are that each sample lot of 5000 tons must achieve blending values of greater than 3:1 ANP:AGP and greater than a net neutralization potential of 20 tons $CaCO_3$/kton. Backfill NNP started at around 500 tons $CaCO_3$/kton or more and has declined steadily as limestone stockpiles have depleted and use of other rock types increased. In May 1998, the NNP for the backfill rock alone was 313 tons $CaCO_3$/kton. In July, the NNP of the backfill rock had declined to about 302 tons $CaCO_3$/kton, or about 347 tons $CaCO_3$/kton including cement. Overall net neutralization potential of rocks in the mine that would participate in acid generating and neutralizing reactions, including the crown pillar and backfill, would be on the order of 4.16:1 NP:AGP and NNP 325 without cement, or about 4.19:1 NP:AGP and 327 NNP with cement for the 1995 ROD authorization, based on backfill reports through July 1998 and EA document #36, Appendix F.
The Schafer evaluation that was set forth in two October 9, 1997 memoranda presented the results of modeling efforts focused on potential impacts associated with an increase in PAG backfill tonnage and an increase in limestone passivation on backfill neutralization potential. The addition of as much as 2 million tons of PAG rock was modeled as backfill in one of the computer runs and the water quality that resulted was evaluated. The October 9, 1997 technical memorandum concluded: "Results of the modeling efforts indicate that the backfill at the Lamefoot Mine has ample neutralization potential under both current and any foreseeable future expansions which would generate additional PAG	1-21	1-21: The 1998 model test results were considered. The 10/9/97 sensitivity analysis evaluated placing 1/2 million tons of PAG backfill with mitigation measures including cement followed by 1 to 2 million tons of only PAG backfill. See EA Alternative No. 2 which involves up to 1 million tons of PAG waste rock. Note that the PAG rock in the crown pillar also involves on the order of 1.52 million tons (EA p. 1 from EA document # 36 Appendix F, EA document #37 Table 4-3 and EA document #6 Tables 5 & 6. Total PAG rock in waste rock backfill plus the crown pillar is about 2.52 million tons.

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waste. " Id. at § 3.0 (emphasis added). It is important to note that this evaluation was conducted using waste that was composed entirely of PAG rock. Two different water types were used in the test; the first water type was what the researchers considered the most likely water to fill the mine, and the second was ARD water which the consultants do not believe will fill the mine void. Model runs were conducted by filling and flushing the mine void with both water types.	1-21	1-21 (contd): The evaluation was not conducted using "waste composed entirely of PAG rock". Tables 1 and 2 of the 10/9/97 memo identified that the first 1,814,610 tons of backfill was composed of current backfill estimates based on QA/QC geochemical testing results, 1/3 of remaining operational waste was PAG, and all of North Lamefoot waste was PAG. To this, the model added 1 million or 2 million tons of additional PAG waste. See Response 1-8.
To further test the neutralization capacity of the mine, as much as 85% of the limestone that is available in the mine was modeled as unavailable (only 15% was made available to neutralize acid production). The October 9, 1997, technical memorandum concluded: "In summary, the backfill at the Lamefoot Mine has ample [acid neutralization potential] ANP to neutralize very high levels of acidity and meet the requirements of the ROD, even at high levels of limestone passivation and the conservative conditions of the sensitivity analysis where the entire mine would fill with ARD .... This is true for the existing prediction of backfill composition under the current mine plan as well as for conditions associated with the waste generated by the North Lamefoot expansion or any foreseeable additional expansions, even assuming all this waste is PAG. This is a very unlikely situation; a portion of the waste would likely be comprised of limestone and intrusive, as well as borrow backfill sources ... and cement." Id. at § 2.1 (emphasis added). Further, the 1997 report states that "this exercise underscores the results of past geochemical testing and modeling regarding the high neutralization potential of PAG waste rock which could be generated by future expansion without compromising backfill neutralization potential." Id.	1-22	1-22: See Responses 1-5, 1-8, 1-11, 1-14, and 1-19. Note that the 1997/1998 models were based on use of 5 wt % cement in backfill.
These statements by the geochemical consulting group that was approved by the BLM for this project confirm that the mine will not, as is suggested in this 1998 EA, eventually develop ARD. Even under very rigorous modeling scenarios, the mine will continue to neutralize any acidity that might be produced. The extensive evaluations demonstrate that the mine will not produce ARD in perpetuity.	1-23	1-23: See Responses 1-5, 1-8, 1-11, 1-14, and 1-19. BLM agrees that the geochemical modeling performed in 1997/1998 was rigorous in accordance with CEQ regulations 40 CFR § 1502.22. However, the data and 1995 test results show that ARD production is likely to continue to gradually increase after a long lag time, particularly since the crown pillar may remain exposed to oxidation in perpetuity. As stated in the June 1995 "2750 Level" report by the consultants, p. 4-30, "The production of any acidity is expected to occur in localized fractures near the top of the mine (oxidized zone) where water is present, and to be neutralized within the mine workings."
Page 17, second paragraph: Laboratory tests found low to moderate reactions rates for the clastics and altered limestone rocks indicating that there would be a long lag time before acid generating reactions consumed the neutralizing materials." (Emphasis added.) Again, this incorrectly implies that eventually acid generating reactions will consume the neutralizing materials. In fact, the site geology and geochemical data demonstrate that the ARD potential is negligible. The humidity test studies that the expert consultants carried out were demanded by the BLM. The conditions of the tests were dictated by the BLM and the testing was extremely thorough. The testing was conducted under the direction and close supervision of the BLM, by scientists approved by the BLM, using EPA-certified labs. The tests conducted for the 1994 FEISS, and the July 1995, May 1997 and	1-24	1-24: See Responses 1-11, 1-12, 1-13, 1-14 and 1-15. No additional geochemical characterization testing was performed for the May 1997 or May 1998 impact evaluation studies. The geochemical test data used for those studies were blending test results from monthly monitoring, which are not determinative of rock characterization for acid generation, but only give an indication of the thoroughness of mixing of PAG and NAG rock types. See Response 1-14; a number of the humidity cell tests were prematurely discontinued before sulfide oxidation had declined. Those test results are not being accurately interpreted and presented by EBM. The June 1995 "2750 Level" report, Appendix C, p. 4-8, states "There is no clear correlation between the final rinsate pH and the acid potential (AP) of the clastic samples as shown in Figure 4.54. However, among the altered limestone and limestone samples there may be a slight influence of the AP on the final pH. The general conclusion that can be drawn from these observations is that the presence of a large reserve of available NP controls the final rinsate water chemistry to a great extent. Furthermore, because sulfur turnover ratios (ie: sulfide oxidation)(Table 4.2) were typically low (0.1 percent per week or less) it would take several years for these samples to generate sufficient acidity to consume a significant part of the available neutralization capacity." (emphasis added) Historical conditions were examined and page 4-41 states "The water chemistry of samples collected from these areas of the Old Timer's adit is indicative of areas which have formed or accumulated products of sulfide oxidation but the bulk of the acidity has been neutralized. Again, this is consistent with the humidity cell tests which show that there is usually sufficient neutralization potential in the host rocks to provide for neutralization of acid as it forms." (emphasis added). Page 5-1 states "The testing identified the clastic lithology as the only lithology which has an overall ABA sufficiently low to provide a significant potential for acid generation over the long term. The average NP/AP ratio for this lithology in all samples groups tested ranged from 0.63 to 0.77. However most samples in this group have a fairly large NP component which means that, if sulfide oxidation occurs, the development of acidic conditions will not likely occur until the inherent neutralization capacity of the host rock is largely consumed." (emphasis added) (see Response 1-14).
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May 1998 impact evaluations, have all shown that the mine has an overabundance of neutralizing capability and will not produce ARD in the long term or in the short term. Page 17, fifth full paragraph, sentences 3 and 4: Again, the EA suggeststhat ARD will develop, but at a relatively slow rate. This is not true. Extensive tests and analyses demonstrate that ARD will not develop.	1-25	1-25: Existing seepages show that ARD is already occurring locally, and tests conducted in 1995 indicate that ARD may be generated locally over the long term. There are no extensive tests showing or demonstrating that ARD will not develop, but only the potential to neutralize from some of the rock materials tested.
Page 19, first paragraph: This paragraph uses the gross estimated waste rock tonnages that are categorized as PAG or neutralizing, using only general rock type, rather than the lab test information (as discussed in Section I.A above). We believe that the two October 9, 1997 memoranda from Schaefer &Associates should have been cited in this EA. These memoranda detail the results of the evaluations that were performed by order of the BLM and under the close supervision of the BLM. These evaluations were to be done to establish the maximum possible volume of PAG waste rock that could be placed in the mine and still maintain minimal impact. The evaluations were conducted using the parameters that the BLM established in numerous telephone discussions and written correspondence. The results showed that the mine could contain up to 2 million tons of PAG waste rock without creating any negative offsite impacts even when only 15% of the alkalinity was available for neutralization reactions and the mine was filled and flushed with ARD water twice. This was an extremely rigorous evaluation and the results showed that the mine acts as an extremely effective buffering agent if any ARD that might develop, especially when it is virtually certain that 2 million tons of PAG backfill will never be generated during the mine's life.	1-26	1-26: This is a misrepresentation of the character of the rock and it's potential to generate acidity. See Responses 1-5 and 1-6; backfill samples are composites of NAG and PAG rock and do not represent the actual character of either type of material. Backfill testing is used to identify the degree of mixing of NAG and PAG rocks to ensure that the quantity of neutralizing material meets ROD criteria for controlling acid generation. The results did not show the lack of "any negative offsite impacts", and consistently showed elevated levels of sulfate and manganese that would not be attenuated. Although Schafer & Associates relied on dilution to reduce the effects, they did not present any technical analysis supporting the degree of dilution they described. In the Oct. 9, 1997 memo, the consultants conducted a sensitivity analysis with parameters that were not cleared in advance with BLM, and used a strong level of acidity that would ensure reaction of limestone in the model. However, if acidity develops in the more gradual fashion that is expected, limestone is a less effective neutralizer for milder degrees of overall acidity (e.g., Wentzler and Aplan, 1992, Neutralization Reactions Between Acid Mine Waste and Limestone). The Oct. 9, 1997 memo is cited in the references; it is part of Appendix C-3 in the May 1998 "Impact Evaluation", EA reference document 29. One of the ongoing difficulties with modeling work throughout 1997 was repeated running of models and sensitivity analyses by EBM and Schafer & Associates without obtaining advance BLM review and concurrence on the parameters. This was a requirement of the 11/30/94 ROD to ensure that any studies conducted would be acceptable and representative of the situation in the mine.
Page 27, second full paragraph, third sentence: "Over time the sulfides would become oxidized similar to those found in the Old Timer's Adit, although more acidity might be released because the crown pillar and mine walls would be exposed to more moisture than was present in the Old Timer's Adit." This sentence does not reflect the results of the numerous studies that have been performed for the Lamefoot Mine, including the May 1998 "Impact Evaluation for the Proposed Interim Expansion for the Lamefoot Mine." In order to present the most conservative evaluation (i.e., worst case), the study included "all possible subsidence results in the conservative evaluation, the hydraulic conductivity of the crown pillar material has been assumed to be infinite in the mining and post-mining periods." Id. at 9. In the memorandum transmitting the May 1998 Impact Evaluation (May 11, 1998 memorandum from Ed Spotts to Steve McIntosh) the following statement is made: "In addition to analytical data, prior modeling of backfill neutralization potential indicates that there will be ample neutralization potential (NP) in the backfilled mine to neutralize any acid produced via pyrite oxidation. (Emphasis added.) The memorandum concludes that "[t]he conservatism of the modeling effort is underscored by the fact that model flow values were higher and inflow water quality poorer than the values observed in the current monitoring	1-27	1-27: Ventilation tests conducted as part of the 1995 "2750 Level" study documented that humidity is high when the ventilation system is shut down and wall rocks become moist. This was directly observed after only a short shut-down, and was also observed by BLM in parts of the mine with poor ventilation. Projections of mine refilling require re-saturation of the mine walls as water levels re-establish after mine closure, and standing water within mine workings will increase humidity. Sulfide materials are present throughout the mine walls (See response 1-11), and will be exposed to these conditions after mine closure. By contrast, the Old Timer's adit was a short, near surface adit open to natural air circulation with limited moisture exposure. The hydraulic conductivity values used by Adrian Brown Consultants yielded essentially the same effects as those that would be expected from the subsidence model. A memo from Adrian Brown Consultants dated 1/19/98 stated, "These evaluations indicated that the inflow to and outflow from the mine is not particularly sensitive to the hydraulic conductivity of the crown pillar. This happens to be the result of the fact that by the time the conductivity has reached 10 ft/yr. (10-6 cm/sec) essentially all the available water is passing from the near-surface material through the crown pillar, and into the mine."

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program .... These conditions will change negligibly as a result of the proposed interim plan." Id. Page 35, first full paragraph, fourth sentence: "Acid generation in the mine will be slow due to the inherent neutralization capacity of the mine rocks, and self-inhibiting characteristics that slow the reactions at the microscopic level. " (Emphasis added.) This statement implies that the development of ARD is inevitable. This is not consistent with the consultants' evaluations and previous EAs produced by the BLM. According to the technical memorandum from Schafer and Associates to Steve McIntosh, dated October 9, 1997, "[r]esults of the modeling efforts indicate that the backfill at the Lamefoot mine has ample neutralization potential under both current and any foreseeable future expansions which would generate additional PAG waste." (Faxed to BLM on October 10, 1997.)	1-28	1-28: The mine has already demonstrated that ARD can occur locally, and the June 1995 "2750 Level" report indicates that it can be expected to occur elsewhere in the mine after a long lag time, (e.g., p-4-30), "The production of any acidity is expected to occur in localized fractures near the top of the mine (oxidized zone) where water is present...". See Responses 1-11, 1-13, 1-14, and 1-23. The question is not whether ARD will occur, but when and how much, and whether the neutralization potential of the mine is sufficient to counteract acidity that may be generated. From a broad perspective, the 1997/97 models and sensitivity analyses indicate that there will be sufficient neutralization capacity available to maintain a neutral environment in the mine. The mitigation measures are specifically intended to place this neutralization as close to the ARD sources as possible to minimize ARD generation, which should minimize the amount of by-products from neutralized acid generation and control water quality impacts.
Page 35, third full paragraph, first sentence: 'These same factors are less conservative when applied as backfill blending criteria for a mixture of rocks with dissimilar characteristics in an attempt to replicate non-acid-generating characteristics as a control measure. " This statement is unsubstantiated. At best, this is a general statement that evidence indicates does not apply at Lamefoot. An NP/AP value of 3:1 provides three times the neutralization capacity that is required to neutralize one part acid. As stated previously and repeatedly by the consultants, the Lamefoot waste rock has an abundance of alkalinity. This implication that the 3:1 management level may be inadequate is not supported by the studies or the previous BLM decisions.	1-29	1-29: EBM's comment is incorrect, and contradicted by substantial data in the literature. For example, a study by diPretoro and Rauch, 1988, stated "Every sampled mine is producing drainage with negative net alkalinity if it has an NP to MPA ratio of less than 2.4." ..."and " sites with RATIO values greater than 2.4 are most likely to produce drainage having positive net alkalinity; sites with RATIO less than 2.4 are most likely to produce drainage having negative net alkalinity." Cravotta, et al. (1990), noted that "4 moles of CaCO$_3$ are required to neutralize the maximum potential acidity produced by 1 mole of FeS$_2$" instead of 2 moles of CaCO$_3$ as implied by EBM. Brady, et al. (1990) noted that, "The results of this study are consistent with previous reports that concluded that NP and "traditional" MPA values, despite being reported in the same units (tons CaCO$_3$/1,000 tons), are not equivalent. In previous practice, it appeared that overburden NP must be at least twice MPA to produce alkaline mine drainage (diPretoro 1986; Skousen et al. 1987; Brady and Hornberger 1989; Ferguson and Erickson 1988)." Brady also noted "other factors, such as unequal distribution and exposure of the acid-forming or neutralizing materials and hydrogeological variability, complicate the evaluation of relative effectiveness of using different alkaline materials and placement of the acid- or alkaline-producing materials." Day, 1994, (Evaluation of Acid Generating Rock and Acid Consuming Rock Mixing to Prevent Acid Rock Drainage) concluded that "The actual quantity of limestone required to prevent acid drainage in perpetuity would probably be at least twice that determined by conventional acid-base accounting provided that the limestone and rock are intimately mixed..." Mehling, et al., 1997, (Blending and Layering Waste Rock to Delay, Mitigate or Prevent Acid Generation: A Case Study Review) found in one case study that, "NP ratios of at least 2:1 for blended waste rock and finely crushed limestone would be required to control acid generation in the long term" (emphasis added) and " Blending did not reduce sulphide oxidation rates in the potentially acid material unless highly reactive neutralizing material (limestone) was applied, and the blending was near ideal, as in column or humidity cell tests. ... Almost all of the small scale tests have, at best, delayed the onset of acidification." Rescan Environmental Services Limited, 1990, found "blends of pyritic vs. nonpyritic waste rock (1:6) will continue to produce acid but will be effectively neutralized by carbonate materials in the waste pile. Blends of the 5-year ratio (1:2.5) ... will eventually consume the carbonate .. and continue to produce acid drainage in the long term." Bradham and Caruccio, 1997, (Acid Base Accounting Success Rates in Acid Mine Drainage Laboratory Predictive Tests), found, "No ABA interpretation technique resulted in clearly defined acid or alkaline sample clusterings. 100% confidence for alkaline leachate, i.e., 0% occurrence of acid leachate production, was achieved only for a neutralization ratio, NR (NP/MPA) of at least 19."
Page 35, fourth full paragraph, last sentence: "The addition of cement after the materials are mixed to meet the non-acid-generating criteria will also add additional neutralizing capacity to the backfill and help in counteracting acid-generation by placing that neutralizing capacity indirect contact with exposed sulfides. " The test data and studies clearly indicate that this statement is true. However, the BLM has not accounted for the chemical contributions from cement in the evaluations on the potential of the mine to produce acid. Echo Bay submitted the cement that is used in the mine to a laboratory for ABA testing and presented the test results in the Schafer report titled "An Evaluation of Potential Replacement Backfill Sources for the Lamefoot Mine, July 20, 1995". The test results show that the cement has a significant capacity for neutralization. As stated in the report, "Echo Bay submitted a sample of Portland cement to be used in the cemented stopes for ABA analysis. The proposed use is to mix the cement with waste rock. As expected, the NNP of the cement is very high."The Schafer report concluded: "[t]hus, at a cement addition rate of 7% (Echo Bay 1995), and the average cement addition to each ton of waste, the resultant NNP added to the waste rock stockpile material would be (8.97 X 7; or 897 X 0.07), or 62.8 T CaC03/Kt." To date, an estimated 27,000 tons of cement have been added to the mine as cemented rockfill for a total addition of about 1,700 tons of CaC03. The 1995 EA (at 13) contains the correct statement 9	1-30	1-30: This incorrect on several counts. BLM has addressed cement content in the FEISS, 9/20/94 EA and 1998 EA, and cement was included in the 1997/98 models (see Response 1-8). The approved plan of operations calls for "3 percent for underground limestone, and 4 percent for underground clastic aggregate. ...Currently, the preferred cemented rockfill mix is a 6-inch maximum particle size with 5 percent cement, ..." Monthly backfill reports only document the addition of 5% cement by weight. EBM has not provided any evidence that a "cement addition rate of 7%" is used in the mine. EBM's description is contradicted by the monitoring data, and overstates the amount of cement, implying that there is about 1.4 times more cement than was actually used.

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that "cement will be added to the mixture, which will further increase the neutralizing capacity and reduce the exposure of the reactive rock." Though the neutralizing capacity of the cement has been verified, the BLM inexplicably has specified that the monthly reports that show the backfill chemistry must not include tests of the cement that is put in the mine. Because of the significant additional neutralization that is added by the cement, along with the physical benefits, the neutralization of the cement should be taken into account when evaluating the monthly waste inventories. In the first part of the 1998 EA, the PAG tonnages that are backfilled in the mine are discussed at length, but the significant additional alkalinity added by cement is not discussed nor presented in the calculations.	1-30	1-30 (contd): Samples are required to be blended to ROD criteria without counting the cement content to ensure that distribution and blending is adequate on the basis of NAG and PAG rocks alone to prevent localized "hot-spots" from developing. EBM's methods frequently fail to achieve such blending levels (see Response 1-5). Neutralization capacity in the backfill is intended to provide neutralization for all PAG rocks in the mine, including the crown pillar, so cement content cannot be relied on solely to compensate for inadequate blending of PAG and NAG rocks. Cement content is taken into account as part of the overall combination of methods intended to prevent, minimize and control acid generation in the mine. See Response 1-8.
II. GROUTING A. The EA Places Unwarranted Reliance On Grouting As A Mitigation Measure.		
Page 3, last paragraph, sentence 2: The 1998 EA places unwarranted reliance upon grouting as an environmental control measure. The positive impacts that are ascribed to grouting in this document are completely unsubstantiated. For example, the 1998 EA states: Grouting was a measure relied on in the FEISS as a means of slowing diffuse outflow of mine water and seepage into surface water and shallow groundwater in the Wolf Camp drainage and preventing direct discharge into the drainage through boreholes.	1-31	1-31: Grouting is a fundamental control measure that was developed in the FEISS. In 1993 and 1994, EBM developed the mine plan in conjunction with development of the FEISS by EBM's contractor, Woodward Clyde Consultants (WCC). As WCC identified potential impacts, EBM proposed and committed to perform mitigation as part of the proposed action, and impacts were then analyzed in the FEISS based on the committed measures. With regard to groundwater seepage into the mine and seepage of mine water out of the mine post-closure, EBM's Proposed Action in FEISS Section 2.3.5.1 (p. 2-10 to 2-11) included "grouting drill holes, fractures, and seeps" and stated "Echo Bay will perform drilling and grouting operations from the underground workings as necessary to reduce water inflow at points of substantial seepage. Grouting would be performed at locations where the workings intercept faulted or fractured zones of rock with inflows of 1 gpm or more. ... The composition of the grout mixture will be selected to resist degradation under the geochemical conditions expected to occur in the foundations encountered during mining and post-closure" "Echo Bay has committed to two mitigation measures to reduce mine inflow ... a program of underground grouting" FEISS, p. 4-3. In the Preferred Alternative that was selected, grouting was adopted subject to use of the best available technology, "Examples of best available technology include using high penetration grouts (e.g., microfine), high-speed centrifugal mixers, and high-sulfate-resistant cement." The grouting requirements in the ROD are based on EBM's Proposed Action, as modified by the Selected Alternative.
Echo Bay does not oppose the utilization of grouting, but it must not be imposed to an excessive degree in the ROD conditions to the point where it interferes with mine operations and causes unnecessary substantial expenditures of funds and personnel resources. Echo Bay has implemented a grouting program at the direction of BLM which we believe is based on a misinterpretation of the relevant decision documents. Due to this difference in interpretation, Echo Bay has implemented the grouting program under protest. In truth, grouting is of doubtful environmental value, contrary to the statements in the 1998 EA. Grouting or the addition of cement to an open borehole unquestionably would be an effective measure for closing boreholes. However, the statements that grouting would slow diffuse outflow of mine water and seepage into surface water and shallow groundwater is purely speculative. In fact, the consultants have stated quite clearly that grouting would have negligible or no impact on the flow of water from the mine as a whole. See generally Comments of Adrian Brown Consultants (Aug.13, 1998), and Comments of V. Straskraba, TRC Hydro-Geo Consultants (Aug. 13, 1998)	1-32	1-32: EBM did not perform grouting as required in the 11/30/94 ROD and provided misleading reports to BLM about grouting status. After being asked to produce grouting records, EBM responded with a fax on August 15, 1997 stating, "Grouting at the Lamefoot Mine has been performed at locations where the workings intercept faulted or fractured zones of rock with inflows of 1 gpm or more as specified in Section IV,E,1(a) in the November 1994 Record of Decision for the Lamefoot Mine. Since late 1994 grouting operations have been done as part of the cable bolting program." When grouting records were still not provided to BLM, EBM finally acknowledged in a letter dated April 27, 1998, "No grouting occurred from November 1994 until March 24, 1998." At that point, BLM directed EBM to start the grouting program. EBM's FEISS consultant predicted a 50% reduction in flow, as noted in the FEISS, Table 4.1-1 and explained on p. 4-3 and 4-4 "estimated inflow to the mine at the 2200-foot level is reduced by 50 percent" and "The discharge of mine water through permeable zones will be minimized by the committed mitigation measure of grouting any sources of inflow greater than 1 gpm. The grout is expected to provide a long-term effective reduction of permeability to the rock zones that are grouted" (see also EA reference document 50). TRC Hydro-Geo Consultants confirms that a 50% reduction in flow is well within achievable limits for grouting projects in mines (see Comment 4-4 and BLM response). The June 1995 "2750 Level" Report, Appendix A (page 22), stated that "The inflow rate appears to have been dropping steadily since the mine was originally opened ... This reduction may also be a sign of the effectiveness of the grouting which is performed for all drill holes which make water". (emphasis added).

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(submitted herewith). The program of grouting boreholes (both surface and in-mine) and fractures should be completed prior to mine abandonment and should respect the mining plans and accessibility to borehole locations.	1-32	1-32: Holes must be grouted during operations to ensure that grouting takes place. EBM's past performance has not demonstrated great reliability. The approved Plan of Operations specifies " Once commercial production begins, drill holes and discontinuities which produce water will be routinely grouted." EBM's difficulty in locating holes in 1998 demonstrates the need to conduct grouting concurrent with operations. Stoping may expose boreholes that will become inaccessible after backfilling takes place and access may be blocked to other holes. Surface and underground holes that are left open for years may fail and become partially blocked due to rock fill or local collapse. In such cases, the blockage may prevent complete grouting but the portion of the hole below the blockage may continue to provide connections of zones and fractures. Fuenkajorn and Daemon, 1996, note that "One of the most important factors to be considered when planning the sealing of boreholes is the condition of the holes. ... For long-abandoned holes it must be considered likely that some debris may have been dumped in the hole. Depending on the rock types penetrated, the probability of hole failures, collapses or sloughing must be evaluated."
The overall flow into and out of the mine would likely not be affected in any measurable way by grouting, regardless of the or thoroughness of the grouting measures. The 1998 EA's reliance on grouting for mitigation of impacts on groundwater is completely speculative. To our knowledge, no other mine in the world utilizes grouting as an environmental mitigation measure in the manner required by BLM at this site. To imply that grouting is an accepted means of effecting groundwater mitigation in an underground mine is completely without basis.	1-33	1-33: The EA's reliance on grouting is based on the FEISS and the 11/30/94 ROD. EBM's consultant, WCC stated, "The assumption of 50% flow reduction was based upon professional judgment, considering that most points of inflow approaching 1 gpm in the current workings have been from drill holes that have been grouted or otherwise sealed. It is expected that as workings proceed from the current 2615 ft. elevation to the maximum depth at the 2200 ft. elevation, the hydraulic head on a fracture zone of a given hydraulic conductivity will increase with depth, and the resultant flow from that fracture zone would increase in proportion to the hydraulic gradient. Based upon this reasoning, more individual fractures would be expected to yield greater than 1 gpm as mining progresses to greater depths. Therefore, more grouting may be needed to control mine inflow as depth of the mine increases. Considering the above factors, the approximation of a 50% reduction due to grouting is technically justified." (EA document 50)
The regrettable fact is that mine operations may be seriously harmed by the implementation of astringent and costly grouting program, while the effectiveness of the grouting is in serious question.	1-34	1-34: BLM has discussed grouting with EBM many times since 1994. EBM proposed a grouting program as mitigation for the Proposed Action, and was aware of the 11/30/94 ROD requirements at the start of mining. Such costs should have been factored into the mining operations. Any additional costs for remedial grouting due to EBM's failure to perform grouting concurrently with operations from 1994 to 1998 according to the 11/30/94 ROD and approved Plan of Operations are a result of EBM's own inaction.
Page 13, last paragraph, sentence 3: "Drill holes were open into several water zones and producing water during drilling operations for over a month prior to the time discharge tests were conducted. " This is not accurate. The boreholes drilled from the 2225 N exploration drift encountered ground water inflow at the depth of penetration of the Wolf Camp Fault. The discharge from boreholes, measured up to about 50 gpm, was controlled most of the time during drilling and occurred only during the interruption of drilling operation. Drilling of most of the boreholes (70 to over 400 feet deep) was completed within 8 to 10 hours and during this time only a limited amount of water discharged into the mine. Packers were installed at each flowing borehole after the completion of drilling to shut-off the discharge. Drillers were instructed to measure borehole discharge during drilling at the time of water bearing zones penetration. Therefore, it is not believed that the discharge from boreholes could be much higher than measured.	1-35	1-35: EBM's comment is not supported by the records. Regardless of what drillers were instructed to do, flow rates from the holes with the greatest flows were not measured at the original time of interception according to the shift reports. These holes were among the first holes to encounter large flows of water. The measurement of about 50 gpm was taken over a month after the initial interception after drawdown had occurred. Only about 107 ft. of head was re-established by shut-in prior to conducting the test, about one quarter of the original head. There is no record of packers being installed "at each flowing borehole after completion of drilling". Drilling on holes that produced water lasted multiple shifts, often for more than one day according to shift reports, and water was reported for multiple shifts. It is reasonable to expect that the holes would produce more water when they were under the initially greater hydraulic head. TRC Hydro-Geo noted similar explanations in the 1998 "Impact Evaluation" for other boreholes, stating "A flow of 20 gpm was noted in borehole 28200-2, east of the fault. It should be noted that 28200-2 is at a much lower elevation than 28200-1 which probably accounts for the flow differences."
Page 14, first full paragraph, sentence three: "When the water zone was initially encountered by the first drilling operations .... the initial flows probably exceeded 50 gpm per hole." This is purely speculative. The test results are presented in the Addendum to the 1997 North Lamefoot Hydrogeologic Study, dated November 17, 1997, which was prepared by Hydro-Geo Consultants. The initial flows that were encountered in the drill holes were measured by the drillers. The hydrologic tests were conducted in cooperation with the BLM. It is important to make the distinction between "flows" and the short term release of stored water. In several places in this document it is stated that a fracture or hole carries a flow of a given magnitude. However, as in the sentence cited from the 1998 EA here, the 50 gpm that issued from the test holes in the 2225 drift flowed at this rate for only a short period of time. Hydro-Geo has stated that 11	1-36	1-36: See Response 1-35. The initial flow was not measured by the drillers for these holes. See shift reports for 28100-1, 2, and 3. The hydrologic tests were performed after consultation with BLM, but BLM was not informed of the true magnitude of the test flows until a month after the tests were performed.

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the fracture does not necessarily have a constant flow rate of 50 gpm, but that 50 gpm is the result of a short term release of water from storage. In the hydrologic test that was conducted as stated in the HydroGeo report: "[a]fter 110 minutes, flows had declined to between 0.63 g.p.m. and 4 g.p.m., a greater than 90% drop from the initial rate." This clearly indicates that the 50 gpm flow value represents the flows that were initially released from the drill holes and that the flows diminished rapidly after the initial release of water.	1-36	1-36(contd): Since the test was run at a head less than one-quarter of the head that existed at the time of initial drilling into the water zone, it clearly indicates that 50 gpm was not the flow initially released. The amount of time it took for flows to diminish initially was not recorded on shift reports, so that is unknown. However, the discharge test conducted a month later involved simultaneous discharge from 5 boreholes. Since the boreholes were drilled one or two at a time, and head was over four times greater, it is reasonable to project that discharge lasted longer at the time of initial interception, particularly if EBM's contention of packer installation after each hole completion is considered.
Page 14, Section 5.1.2.1, paragraph one, sentence three: 'Grouting was intended to alter the groundwater movement into and through the site and change the Affected Environment pre-mining conditions as a control measure. " To alter groundwater movement into and through the site is obviously a monumental undertaking that cannot be effected by grouting, as stated by the groundwater and grouting consultants.	1-37	1-37: Grouting is routinely conducted for dams, tunnels, underground powerhouses, and numerous mines, and is not a "monumental undertaking". EBM grossly overstates the magnitude of the issue. See Comment 4-4; also note that EBM did report that numerous holes were grouted in 1994.
Sentence five states that "implementation records are lacking details so there are now some uncertainties about when, where and how grouting has been performed to date." Echo Bay conducted grouting according to the conditions which were in effect at the time that the grouting occurred. The records were maintained in the detail required by the relevant BLM decision documents. Regardless of the quality of the past records, the mine performs "drip surveys" every month and submits the results to the BLM in monthly reports. These surveys show how much water is produced within the mine. The seep surveys that have been conducted since mine startup are being used to identify any areas where groundwater has ever entered the mine void at a measurable rate.	1-38	1-38: The amount of water being produced now in the mine is not indicative of the amount of water that may be released through fractures and boreholes when the mine refills. Drawdown has dewatered much of the rock overlying the mine creating a cone of depression in the groundwater surrounding the mine. See EA Figure 9.
Page 14, last paragraph, sentence one: "However, there are discrepancies about whether all holes were grouted. " In response to this concern, Echo Bay undertook a thorough field review of the Lamefoot surface. This survey involves field identification of drill holes, review of the reclamation requirements, and a field inspection of the hole. A preliminary report is scheduled for BLM review by early fall. Page 15, second full paragraph, second sentence: 'As a result, a high potential may exist for interconnections that could allow outflow of mine waters after the mine refills, including possible direct discharge to the surface or near-surface with essentially no attenuation. " These statements are unwarranted. As stated in the previous paragraph, Echo Bay is conducting a thorough field review of the drill locations at the present time. Echo Bay has contracted with a drilling company to close any holes that are not already reclaimed. Therefore, it would have been more appropriate to state that Echo Bay is conducting a survey and, based on the results of the survey, will close all drill holes which are determined to require closure.	1-39	1-39: In a fax dated August 20, 1998, EBM notified BLM that "the drill hole inspection work is not anticipated to be completed until fall of 1998 (October 30, 1998), at which time it will be delivered to BLM." EBM did not deliver the survey results to BLM until October 8, 1998. The issue is whether there are ungrouted boreholes and that still has not been resolved. The inventory listed 372 holes as sealed and reclaimed. EBM's report indicated that 26 open holes were found (excluding monitor wells) and 9 holes could not be located, or a total of 35 holes needing or potentially requiring plugging. EBM indicated that it planned to continue to attempt to locate the nine holes. EBM has not provided details to BLM about a contract with a drilling company. EBM has indicated that a drilling company is plugging the open holes, but has not provided any records to BLM documenting these grouting operations on surface boreholes. BLM must base its decisions on information that is available at the current time and not on information that is promised for delivery at some unspecified future date. Although EBM takes exception to BLM's analysis about possible interconnections, EBM has provided no evidence documenting the lack of connections. To the best of BLM's knowledge, EBM and its' consultants have never conducted testing to show or define any aspects of the connectedness or flow systems associated with the complex faulting and jointing that exists at this site. EBM has tested areas adjacent to faults and jointing systems, but that is not the same as a field program to analyze for faults and jointing systems as the comments infer.

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Page 24, last paragraph of the first column: 'The grout specified in the 11130194 ROD is more chemically resistant, will have greater penetration into fractures, and will be more likely to fully seal fractures; as a result, it should last longer the 1994 grouting before deteriorating under the water quality conditions predicted post-closure in the mine. " According to the 1995 EA, the "test conclusions were that the mine water would likely remain in the near-neutral range during filling and that acid-generating reactions would cease after refilling as the oxygen supply is removed."The most recent studies confirm this statement. Section 4.0 in the May 1998 Impact Evaluation states:"Geochemical modeling indicates that post-filling mine water will have a slightly alkaline pH (7.4) and low metal concentrations, which will be in part further attenuated as water flows through adjacent fault material and alluvium. "' (Emphasis added.) Further, it is stated in summary that "the findings corroborate previous modeling efforts and indicate that there will be no appreciable impacts to water resources adjacent to the Lamefoot Mine as a result of the proposed interim expansion. " Id. (emphasis added). The statement that the mine would produce low-quality water during mine refilling is incorrect.	1-39	1-39: See Response 1-31. Sulfate reacts with cement, causing it to deteriorate and greater concentrations have more effect. Pre-mining levels of sulfate reached 610 mg/l sulfate (see EA p. 15). The modeling in the 1997/98 "Impact Evaluation" predicted sulfate concentrations as great as 2207 mg/l, which was consistent with 1995 predictions of up to 2560 mg/l (see EA p. 28). The 1997/98 "Impact Evaluation" stated that, "Through time, the mine void water chemistry is actually expected to be similar to the pre-mine background water chemistry in the mine area as upgradient groundwater from the east flows into and through the mine. The maximum concentrations of sulfate would react with the cement grout, as would the reduced concentrations that might eventually be reached after decades. The 11/30/94 ROD, Section IV.E.1(a) Underground Grouting Program requires "using high-penetration grouts (e.g., microfine), ... and high sulfate resistant cement." With regard to overall water quality impacts, see EA 6.2.1.5.
Page 24, last paragraph, sentence 3: 'Water quality within the mine is predicted to degrade ...over time so the quality of any discharges would decline. " Refer to the above discussion. This statement is entirely unsubstantiated. The studies show that mine water will not degrade over time. Further, the statement suggests a discharge of pollutants from the mine which is without any basis.	1-40	1-40: See 1997/98 "Impact Evaluation" Table 3. Sulfate and manganese concentrations are predicted to increase over time as the mine refills and to remain high compared to upgradient and downgradient background water quality.
Page 25, Table 4: The values presented in Table 4 are not supported by any field data. This table presents numbers that indicated that grouting has a quantifiable impact on flows coming into the mine. The estimated reduction in flows that are suggested in the Woodward Clyde memorandum are pre-mine estimations of grouting effectiveness that are not supported by any information collected during mining. To quantify flows in 1998 as in Table 4 based on an early pre-mine estimate made in 1994 is inappropriate. Page 27, first partial paragraph, last sentence: "The model in 1998 evaluates the effect of outflow through the crown pillar, boreholes and other outflow pathways that might prevent complete refilling of the mine void. " (Emphasis added). The 1998 model did not evaluate the effect of outflow through the crown pillar, boreholes etc. The following statement is contained in the enclosed August 13, 1998 comments from Adrian Brown Consultants to Steve McIntosh: "In addition to using hydraulic conductivity tests from ungrouted rock, no changes were made to the model hydraulic conductivities of the materials near the mine to allow for any reduction of hydraulic conductivity which may result from grouting." Id. at 7. Page 28, first full paragraph: 'However, if grouting is performed as required, mine water outflow through faults and fractures under all scenarios would be slower	1-41	1-41: Adrian Brown Consultants' modeling study provides information that supports the Woodward-Clyde Consultants predictions. Adrian Brown Consultants statement notes that the model is based on ungrouted conditions. However, the records supplied by EBM indicate that some grouting was performed in 1994 prior to the 11/30/94 ROD. The results of Adrian Brown Consultants modeling indicate that the discrepancy between ABC's modeled predictions of inflow and the lower amount of actual inflow recorded by monitoring may be due in part to reduction of inflow caused by the 1994 grouting (see Response 1-32). The sentence quoted from the EA says nothing about modeling of grouting, nor is that implied. Just the opposite; grouting was not modeled, therefore BLM's analysis included a projection for the effects of grouting in accordance with CEQ 1502.22. EA Table 4 footnotes specifically identify, "*Inflow reduced 50% by grouting all points of inflow (50) >1gpm per FEISS Table 4.1-1 and 11/30/94 ROD". Adrian Brown Consultants June 1998 supplement to the May 1998 "Impact Evaluation" , Section 3.3 Parameters, part 3.3.6 Backfill, states "Because the backfilling program does not backfill the access excavations, and because unbackfilled access drifts will remain in the mine after closure, it is assumed in all analyses that all the materials within the boundary of the mined orebody ... are infinitely permeable. This assumption is made in order to ensure that the analysis is conservative (that is, produces a high estimate of inflow and throughflow). It is equivalent to an assumption of total extraction of all material within the envelope of the mined orebody, with no backfilling, grouting, or any other flow control, and is modeled in this fashion." EBM incorrectly states that "hydrologic and grouting consultants have not provided any statement that grouting as required would alter the groundwater flow". EBM's consultant, Woodward-Clyde Consultants, predicted a 50% reduction of inflow in the FEISS (see Response 1-33 and EA document 50). No data collected during mining refutes the Woodward-Clyde prediction or indicates that it should be revised. Some grouting was performed in 1994 and water inflow decreased during the same time period (see EA Figure 10 and Responses 3-2 and 3-30) and the decrease lasted until mine workings increased in size. BLM does not agree with Adrian Brown Consultant's conclusion that "grouting has little effect". See Response 1-33, 1-41, 3-30, Comment/Response 4-2, and Comment/Response 4-4. The effects of grouting were considered by BLM's analysis using FEISS predictions, not modeling by Adrian Brown Consultants. TRC Hydro-Geo notes that grouting has achieved as much as 60 to 95% reduction in flow at other mines. Grouting has been successful worldwide for over a hundred years in reducing flow for a variety of types of projects. The impact of discharge from the Lamefoot Mine is certainly influenced if there is a direct release of unattenuated mine water to the surface through an ungrouted borehole (see EA Table 10 and Section 6.2.1.5).

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and more diffuse, and the outflow rate would be less than the amount modeled under the"'expected "'and ""conservative" scenarios. Since the outflow rate would be less, dilution would be more effective in reducing the concentrations as illustrated in Table 4. " This statement is speculative and unsupported by the data. The hydrologic and grouting consultants have not provided any statement that would suggest that grouting as required would alter the groundwater flow through faults and fractures and certainly did not relate a reduction of flow from grouting to the modeling that was performed. See enclosed comments from Adrian Brown to Steve McIntosh, dated Aug. 13, 1998.Mr.. Brown has stated as follows: Accordingly, the grouting has little effect in reducing the total inflow to the mine during operations or reducing the total flow through the mine after closure .... In summary, the grouting has little impact on reducing total flow to and through the mine, and in any event the impact of discharge from the mine after refill is not influenced by the total flow through the mine. Therefore, grouting is not an effective or needed activity with respect to protection of the environment.	1-41	1-41: The statements in the FEISS and 1998 EA are a reasonable prediction of the effects of grouting. Even Adrian Brown Consultants concedes that grouting would be effective in sealing boreholes. Adrian Brown Consultants' Comment 3-18 states "It will if desired be possible to prevent all the flow emerging at one location if it does actually occur, but plugging the conduit along which it is passing, whatever it is." Even the June 1995 "2750 Level" Report notes, "The inflow rate appears to have been dropping steadily... This reduction may also be a sign of the effectiveness of grouting which is performed for all drill holes which make water". (emphasis added). The effect of the grouting conducted from April through September 1998 in the lower portions of the mine has been documented by monitoring data. On March 5, 1998, the water elevation in LF-14 was about 2138.39 ft. Water levels in monitor well LF-14 rose about 239 to 261 ft. since April 1998. As of September 1998, the water elevation in LF-14 was at about 2377.5 ft. Also, water inflow to the mine from April through September 1998 has averaged about 4.2 gpm compared with an average inflow of about 24 gpm for the period of April through September in 1996 and 1997.
Id. at 6-7 (emphasis added). With respect to the BLM's contention that grouting must be accomplished according to BLM specifications or the models that were performed on mine impacts would be invalidated, Mr. Brown makes the following statements in his August 13, 1998 comments:"The modeling performed by Adrian Brown Consultants, Inc. does not utilize or include the effects of the reduction of average hydraulic conductivity in the near-mine rocks which presumably is the result of grouting of fissures." Id. at 7. These statements further invalidate the claims made concerning grouting and the reduction in flows presumably resulting from grouting that is presented in Table 4.	1-42	1-42: Reducing the rate of outflow would increase the proportion of upgradient water relative to the amount of mine water. This would result in greater dilution. Dilution predictions are also presented in the FEISS (e.g., see Section 4.3.2, Summary item 4 on p. 4-15).
Page 29, fifth full paragraph, first and second paragraphs: "If grouting occurs during mining as planned, outflow may instead occur in a diffuse manner either through the Wolf Camp or Gravel Pit faults as identified in the hydrological model or through fractures in the crown pillar. Under those circumstances, the slower rate of outflow would have substantial dilution as indicated in Tables 9 and 10." These statements and Table 9 are unsubstantiated since neither the statement nor the dilution calculations are supported by the expert consultants in the fields of grouting and hydrology. In fact, the statements in the enclosed Adrian Brown Consultants comments, dated August 13, 1998, provide clear indication that grouting will have a negligible impact on the flows from the mine.	1-43	1-43: The total extent of analysis of dilution in the 1998 "Impact Evaluation" report is presented in supplemental pages of June 15, 1998, which state "the modeling does not account for any effects of dilution that can occur as groundwater migrates from the mine void west, into the adjacent bedrock, potentially lowering constituent concentrations." (emphasis added). The 1998 "Impact Evaluataion" did not provide any calculations of dilution or any documentation defining how much dilution would occur between the Lamefoot Mine and wells east of Curlew Lake other than those in the FEISS, and no supporting documentation or calculations on dilution were subsequently provided by EBM or it's consultants even though they were invited to do so. A strict reading of the wording of the report could also infer that "potentially" dilution does not lower constituent values, but BLM's analysis and past analyses in the FEISS indicate that it is reasonable to attribute some degree of dilution. BLM's calculations in Tables 8, 9 and 10 provide a realistic estimate of the possible reasonably foreseeable adverse impacts in accordance with CEQ regulations under 40 CFR § 1502.22. Information from the FEISS analyses and supporting data developed Adrian Brown Consultants for model parameters was sufficient to estimate a range of possible dilution for impact analysis purposes.
Page 33, first paragraph, third sentence: "Grouting in accordance with the plan of operations in advance of the extension of exploration drifts should seal 14	1-44	1-44: These measures have already been coordinated with EBM with over three years of discussions and are part of the Plan of Operations (approved 12/12/96), Section K.3.3, which states, "The main purpose of grouting is generally to reduce permeability of the fractured zones in bedrock ahead of advance of mining." (emphasis added). EBM has been requested numerous times to prepare a grouting plan that identifies areas that will need to be grouted in advance of mining, but EBM has not yet produced such a study or analysis.

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fractures that are encountered when discharges are readily identifiable and before they are dewatered by the continuing drawdown." This statement requires clarification in the ROD. This statement suggests that grouting may be required in advance of mining, regardless of whether or not water is encountered. Any requirements involving grouting in advance of underground development activities must be carefully coordinated with Echo Bay's mining engineers to ensure that operations are not unnecessarily disrupted.	1-44	1-44(contd): BLM has advised EBM on numerous occasions to prepare a grouting plan for scheduling of grouting operations to avoid such disruptions. EBM has declined to prepare such a plan until now (see Comments/Responses 1-68 and 1-69).
Page 33, Section 6.3.1, third paragraph: "Information now indicates that direct discharges to the valley through boreholes may be more likely due to uncertainties in the extent of grouting. "This statement is unfounded. As explained above, the grouting will have a negligible impact on flows from the mine. In any event, however, Echo Bay recently proposed to undertake a thorough field research of the Lamefoot area to identify the reclamation that was conducted on all the surface drillholes in the area. The review was initiated in June and the preliminary evaluations are now being reviewed. The results of that review will be discussed with the BLM later this summer and in the fall.	1-45	1-45: An ungrouted borehole will provide a direct release of mine water to the surface and would have the effect of channeling the overall mine discharge through that one outlet without attenuation. Had EBM kept records as required by the ROD, it is likely that a field inventory would not have been necessary. Neither the preliminary results of EBM's survey nor a completed inventory have been provided to BLM. See Response 1-38.
Therefore, to suggest an impending disaster of unknown proportions involving the drill holes in the vicinity of the Lamefoot Mine is not appropriate. The results of the field survey will indicate whether the holes are closed and provide an indication of the reclamation techniques which were used to close the holes. If improperly closed, the holes will be sealed according to the relevant stipulations.	1-46	1-46: The upper limits of groundwater quantity have been identified by groundwater modeling and the greatest concentrations predicted for water quality impacts within the mine void have been determined through geochemical modeling (see 1998 "Impact Evaluation" report). As the EA notes on page 4, the analysis is conservative. Therefore, the EA analysis does not involve "unkown proportions". As noted in the EA (p. 14 and 15), hundreds of holes have been drilled, and since grouting was not performed from 1994 to 1998, many ungrouted holes have stood open for years which may prevent adequate sealing of the borehole because of blockages (see Responses 1-32 and 1-45).
III. SUBSIDENCE A. The Minimal Subsidence Projected At The Lamefoot Mine Has No Direct Correlation To Hydrologic Flow. Page 7, paragraph 6, sentences 2 and 3: "BLM had an independent evaluation and modeling performed to analyze the potential for subsidence and movement of water through he crown pillar. . . . " The subsidence modeling that was performed evaluated subsidence, but subsidence is not directly related to hydrology. All of the rock mechanics experts were careful to point this out. This 1998 EA repeated statements and references suggesting that subsidence will culminate in an increase in the hydrologic flow. Subsidence is not directly correlated with a change in hydrology, as stated by Adrian Brown, Marc Betournay, and John Abel, on page 9 of the May 1998 Impact Evaluation (second paragraph): "Subsidence does not necessarily result in increased vertical hydraulic conductivity. The actual conductivity of this material will be less than the assumed value." Page 23, paragraph 1, first sentence: 'The subsidence analysis indicated that [the] net effect ...of increased void space in the crown pillar may be sufficient to allow all mine inflow to exit through the crown pillar regardless of the specific	1-47	1-47: Dr. Marc Bétournay was not an author of the May 1998 Impact evaluation and did not write the quoted statement on page 9. In the July 1997 CANMET report, the summary concluded, "Rock mass displacements may create voids along the joints that will result in increase of permeability in certain areas within the surface crown pillar. Along with voids in the uncemented rock fill, new potential paths for groundwater flow may be formed around/within the pillar." EA page 39 notes, "the net effect may be that the increase in void space could be sufficient to allow the entire projected amount of mine inflow to exit through the crown pillar." Since the maximum inflow predicted is about 115 gpm, this could potentially be accommodated by a small number of fractures, or even a single fracture. Adrian Brown Consultants used an infinite permeability as a boundary condition, but did not actually calculate the hydraulic conductivity indicated by the results of the subsidence analysis. The June 1998 Supplement to the Impact Evaluation described the results of the CANMET study as, "It is possible that some disturbance of this material may occur when the mining takes place (CANMET, 1997[5]), and that this disturbance may cause some modification of the hydraulic conductivity of the crown pillar material. In order to include all possible subsidence results in the bounding or reasonable worst case hydrologic evaluation, it is assumed that the crown pillar material above the total footprint of the mine void is or will become sufficiently disturbed to eliminate any significant hydraulic resistance from the material." All parties might agree that the actual permeability will be less than infinite. However, use of infinite permeability seems high, but in practice may not yield results that are substantially different from actual impacts. This is explained in a January 19, 1998 memo about the sensitivity analyses, in which Adrian Brown Consultants (ABC) stated, "These evaluations indicated that the inflow to and outflow from the mine is not particulary sensitive to the hydraulic conductivity of the crown pillar. This happens to be the result of the fact that by the time the conductivity has reached 10 ft./yr. (10^{-5} cm/sec) essentially all the available water is passing from the near-surface material through the crown pillar, and into the mine." With regard to the amount of infiltration through the crown pillar, ABC also noted in a memo on April 23, 1998, "the inflow to the mine void is ultimately limited by the available water tributary to the affected area." and "It is agreed that the infinite permeability backfill and the infinite permeability crown pillar assumptions are likely close to the reality which might be expected" (emphasis added).

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amount of inflow predicted." This statement is unsupported by the rock mechanics experts as explained directly above. Page 34, Section 6.4.1, paragraph 4: 'The increased void space of fractures may result in higher permeability and greater water inflow and outflow. " This is an incorrect assumption, as explained above.	1-47	
Page 38, Section 6.5.1, first sentence: "BLM had the Mining and Mineral Resources Laboratory, Natural Resources Canada (hereafter called CANMET) review the revised subsidence model provided by Echo Bay in 1996, and earlier models. CANMET determined that the type of numerical models used in 1995 and 1996 could not have identified the potential effects of subsidence on water movement through the crown pillar and were based on failure mechanisms that would not likely occur at the mine. " This assertion does not account for statements from other qualified experts that have expressed alternative opinions regarding the relationship between subsidence and infiltration. For example, the memoradum from Adrian Brown Consultants to Steve McIntosh dated January 19, 1998 stated: "It would appear that the results of the analyses (CANMET Report and CANMET letter dated 9/4/97) suggest that the effective hydraulic conductivity of the crown pillar will actually be reduced by increased compression in some, perhaps all, locations above the mine (where the water could come in)."	1-48	1-48: EBM has had a number of specialists review the CANMET modeling and analysis. In a letter dated November 25, 1997, EBM's consultant Scott Carlisle stated, "The modeling work done by CANMET appears to be a very reasonable representation of the mine. The models used discrete element methods. This approach is good for the blocky ground conditions observed at Lamefoot. I also noted that some finite element analyses were used for verification purposes. This implies that a thorough job of modeling was done. The results appear to be logical. In general, stress concentrations appear at likely places, e.g., corners of stopes. Displacements also appear generally correct, i.e., bending/sagging of overlying strata into the mined stopes. The areas of compression and tension within the overlying strata also make sense. ...Conclusions ... However, some movement around the periphery of the mine may occur in the zones of tension. CANMET states that these areas, and the mine backfill areas may act as paths of potential groundwater flow. I agree with these conclusions to the point as previously stated, that some overburden material will undergo tension (opening joints), while others will see compression (closing joints). These tend to counteract and should negate any possible increases in groundwater inflow because of the increased leakage path lengths." EBM has already been provided with detailed responses to the assertions Comment 1-48 and others as stated above. In a letter dated January 23, 1998, CANMET noted, "It has been recognized that displacements within a rock mass are not represented by continuum modeling or beam/plate theory for jointed rock massess as used by J. Abel. ... discontinuum modelling, commonly used today for different types of engineering projects that require such application, depends on the balance of forces within the rock mass for blocks to mobilize under gravity and ground stress loading. ... Therefore, the stress distribution, showing very low compressive to tensile values, does have its effects on rock mass displacements as indicated e.g. inter-block openings, contrary to Mr. Brown's conclusion that minor principal stresses are all compresive. If that was the case, aperture movement would not occur. ... Mr. Brown should also understand that uncemented fill has very little effect on elastic rock mass deformation due to its cohesionless, purely frictional resistance. Furthermore, rock bolting support is only applied to the crown of development drifts, the stope walls remain unsupported in this regard." CANMET's response stated, "In conclusion, I believe Mr. Abel's approach varied from ours in that we conducted our analysis based on rock mass and in situ conditions whereas he conducted his essentially with behavior which would not represent a jointed rock mass response. ... Mr. Carlisle, in his comments, agrees with our approach and our mine and rock mass representaion, and is complimentary on the thoroughness and results of our analyses. Agreement is also registered in the time displacement response of the Lamefoot mine geological units. Mr. Carlisle and Mr. Brown anticipate that a "neutral" flow situation will exist after mining, i.e., joint closures will balance out those that are opened or that longer flow paths will exist. Significant joint openings are indicated by our modelling results, more than the anticipated closures. Furthermore, there is a concentration of these larger joint openings at the center of the hanging wall pillar which could facilitate and concentrate flow paths." (emphasis added).
Page 39, first paragraph, first sentence: 'Although the numerical increase seems small (0.4 to 0.8 inch), the net effect may be that the increase in void space could be sufficient to allow the entire projected amount of mine inflow to exit through the crown pillar, depending on the extent of interconnections and the degrees that fractures fully penetrate through the crown pillar. " This statement is unfounded. This suggested consequence is not supported by any of the subsidence report documents, including the CANMET study.	1-49	1-49: EBM's comment is not correct. See Responses 1-47 and 1-49
IV. GROUNDWATER QUALITY A. No Significant Impacts To Groundwater Quality Have Occurred Or Are Expected At The Lamefoot Mine. Echo Bay is pleased that the 1998 EA recognizes that the extensive groundwater monitoring well network in place at the Lamefoot Mine generally shows no adverse impacts from mining, with the possible exception of two wells (LF8 and LF12) where nitrate levels are in question. 1998 EA at 16.The facts involving those wells are explained below and it is clear that they are not indicative of any significant impacts attributable to mining.		
Page 16, second full paragraph, sentence 2: "Groundwater monitoring data indicate that only wells LF8 and 12 have exceedances of groundwater standards that	1-50	1-50: Although Washington Department of Ecology Order No. 98WQ-E382 pertains to elevated nitrate, the sentence in the EA is accurately attributed to EBM's groundwater monitoring data.

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may be attributable to mining-related activities (elevated nitrate)." This allegation is based on the Washington Department of Ecology ("DOE") Order No. 98WQ-E382. Echo Bay has appealed that order and the matter will be resolved after an administrative hearing. To put this issue in context, it is useful to review the July 10, 1998, report entitled "Lamefoot Mine Nitrate Analysis" by Hydro-Geo Consultants, which was sent to DOE, and found, in part, that:	1-50	1-50 (contd): EA document #33, "Lamefoot Mine 1997 Cumulative Trend Analysis Report of Water Quality Data" states on page 10, Item 3, "LF-8 and LF-12 show elevated nitrate concentrations which may be due to runoff from ore stockpiles; infiltration of mine water stored in the infiltration pond; and/or seepage from the mine's septic system. Further investigation of these sources is warranted." The more recent study by TRC Hydro-Geo Consultants titled "Lamefoot Mine Nitrate Analysis ... Final Report, July 10, 1998" further corroborates the monitoring data and concludes, "The combination of high nitrates and fecal Coliform in LF-8 indicates an impact by human, livestock, or wildlife sewage. Since there is no livestock and little wildlife activity near LF-8, the source of fecal Coliform is probably from the Lamefoot septic system. The septic system is hydrogeologically up-gradient of LF-8. Other potential contributing sources of nitrate, up-gradient of LF-8, are the infiltration pond, waste rock stockpiles, and ore stockpiles." and "It is possible that multiple sources contribute to the nitrate concentrations in the ground water at LF-8 and LF-12. Wells LF-8 could have been effected by the mine facilities, but there is not direct evidence to indicate this, with the exception of the mine's septic system at LF-9." (emphasis added). EBM is reminded that the septic system, infiltration pond, waste rock stockpiles and ore stockpiles all involve "mining-related activities". Juul, 1988, concludes there is some naturally elevated phosphorus in shallow groundwater in the Curlew Lake vicinity, but does not identify naturally elevated nitrate. There is little evidence of naturally elevated nitrate in shallow ground water near Curlew Lake in the vicinity of the mine, except for locations near septic systems. The mine facilities are likely to be the source of the elevated nitrate and it is unlikely that the nitrate is natural.
The nitrate concentrations in well LF-8 and LF-12 are higher than the tested leachate from the ore or waste rock samples. The nitrate levels in wells LF-8 and LF-12 are accompanied by bacterial contamination normally associated with the breakdown of organic sediments and human or livestock sewage. Coliforms are also present in wells LF-5 and LF-7 .... Naturally high background concentrations of nitrates exist in shallow ground water near the mine site around Curlew Lake. Depending on the sampling site, this can be attributed to organic sediments, livestock, and domestic septic systems. Samples with high nitrate concentrations and fecal Coliform are associated with shallow organic soils. This is related to contamination by domestic septic systems and livestock, and natural nitrate concentrations in the organic soils.	1-51	1-51: See Response 1-50 for the conclusions of the quoted report.
Id. at 7. In Echo Bay's appeal to the DOE, the company has stated, in part, that neither well (LF8 or LF12) shows nitrate levels in excess of the applicable nitrate concentrations for the requisite numbers of exceedances. Echo Bay has also stated to DOE in its pending appeal that no evidence indicates that the nitrate levels are related to mine water in the infiltration pond.	1-52	1-52: See Response 1-50 regarding mining related activities. BLM is waiting on the outcome of EBM's appeal.
Page 16, fourth full paragraph: "The Washington Department of Ecology allowed further use of the infiltration pond in 199 7. . . ." The DOE had not prior to this date restricted use of the pond. Use of the pond was at the discretion of Echo Bay. Due to the high nitrate levels in the mine water, and the knowledge that the water could potentially impact downgradient monitoring wells, Echo Bay voluntarily undertook a water testing program on the mine water to determine if the water was suitable for disposal in the infiltration pond (nitrate testing of the mine water is not required by the DOE wastewater discharge permit) and a water haulage program to remove the water from the mine and deposit the water in the plastic-lined tailings pond. Both the testing and the water haulage constitute a significant expense that was voluntarily undertaken by Echo Bay to avoid the possibility of contaminating offsite water resources. 17	1-53	1-53: During the EISS process in November, 1993, BLM's review of monitoring data noted consistently high nitrate levels in water discharged to the infiltration pond from April 1993 through October 1993. The potential impact of downgradient water quality was discussed with the Washington Department of Ecology and Woodward-Clyde Consultants. In a letter of December 2, 1993, EBM was advised that, "it appears probable that degradation of water quality within and outside the mine may occur during operations during operations and post-closure. This potential reduction in water quality may be due to increased effluents from the mining process (e.g., nitrates)..." and collection of more information on nitrates was addressed. In October, 1994, nitrates continued to be an issue in the EISS process. During the FEISS process, the testing program for mine water was developed as part of the Hydrologic Monitoring Plan for the Plan of Operations in conjunction with the Washington Department of Ecology and the BLM. The testing program was required by the 11/30/94 Record of Decision, Section IV.E.3 which requires nitrate testing (Table 7), and includes potential requirements for change of explosives and use of water treatment. Many of the downgradient monitoring stations showed elevated nitrates prior to the ROD, raising a question about the nitrate source since most of the wells had been installed in 1994 after the underground exploration workings were in place. For example, nitrate concentrations in September 1994 samples were LF6 (6.44 mg/l as N), LF7 (18.7 mg/l as N), LF8 (30.4 mg/l as N), and MSW (4.4 mg/l as N). In mining operations under the ROD in late 1994, EBM changed to emulsion explosives and voluntarily discontinued use of the infiltration pond. Nitrate levels in the monitor wells have been at lower concentrations since use of the ammonium nitrate blasting agent in the mine was discontinued in 1994. (See Responses 1-56 and 1-67).

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Echo Bay disagrees with the assertion that the mine is the source of contamination of LF8 and LF12. Formal hearings have been scheduled with the DOE to present information to resolve this debate. The investigation that is referenced in this paragraph was completed and the results submitted in a report researched and authored by HydroGeo titled "Lamefoot Mine, Nitrate Analysis," July 10, 1998. In conclusion the report states: "Wells LF-8 and 12 could have been affected by the mine facilities, but there is not direct evidence to indicate this, with the exception of the mine's septic system at LF-8." Id. at 8.	1-54	1-54: See Response 1-50 regarding conclusions of the quoted report.
Page 23, Section 6.2.1.2, second paragraph, last sentence: 'From there, water would travel downgradient about 2300 feet through the alluvium to Curlew Lake. " This flow direction and confluence with Curlew Lake is theorized, but has not been substantiated by research. Further, water movement through the alluvium would result in dilution and attenuation. The degree of either is dependent on a variety of factors.	1-55	1-55: See Response 1-38 regarding the lack of a field program to analyze for faults and jointing systems. BLM did consider the limited new information provided by EBM on general fault and fracture patterns (e.g., January 14, 1998 map). Potential pathways to Curlew Lake were discussed in the EA on pages 25 and 26. Dilution was discussed in the EA in Tables 6-10 and on pages 28-31. The flow direction and confluence with Curlew Lake is supported by known water levels and by the direction of the hydraulic gradient from the mine. This is stated in various reports submitted by EBM, e.g., the June 1995 "Impact Evaluation" report states, "flow in this valley discharges to the west, and ultimately reaches Curlew Lake, mainly by subsurface flow."
Page 27, Section 6.2.1.5, second paragraph, first and second sentences: "In the spring of 1997, the Washington Department of Ecology authorized EBM to resume discharge to the infiltration pond. Monitoring subsequently indicated that nitrates had increased in groundwater near the ore and waste pads to level that exceeded Washington discharge standards at the project are a boundary. " This statement is incorrect in several respects. Echo Bay did not request permission to use the pond in the spring of 1997, because there was no outstanding order stating that the pond could not be used. Secondly, the discussion concerning "discharge" of water and the increase of nitrates in wells "near the ore and waste pads" is not correct. The DOE did not limit the use of the infiltration pond prior to issuance of the DOE Order in May 1998 (Order No. DE 98WQ-E382). Echo Bay voluntarily discontinued use of the pond in late 1994 based on the concern that use of the pond might impact offsite groundwater. In 1996, Echo Bay resumed use of the pond when it was determined that there was a negligible risk of contaminating offsite resources. The statement that Washington discharge standards were exceeded at the project boundary is incorrect. Page 27, Section 6.2.1.5, second paragraph, third sentence: "Monitoring data suggested that this groundwater may be gradually moving offsite toward Curlew Lake."" This is pure speculation and is not supported by the data.	1-56	1-56: EBM may have resumed use of the infiltration pond but in doing so, did not provide monitoring data to BLM in accordance with the Hydrologic Monitoring Plan and the 11/30/94 Record of Decision, IV.E.3.a. A monthly report for June 1996 identified the infiltration pond as "reclaimed". In a letter of March 7, 1997, EBM stated "The purpose of this letter is to provide notification that Echo Bay intends to introduce Lamefoot Mine water into the infiltration pond on or after March 11, 1997." and "At the present time there is no pipeline or other water conveyance structure which connects the portal to the infiltration ponds. Mine water is hauled from the portal to discharge or storage locations in tanker trucks. As an alternative to water meter readings, a record of the number of tanker truck loads that are introduced into the pond will be maintained as a means of determining the volume of water that is introduced to the infiltration ponds. Water volumes will be tallied three times each week, along with field water quality parameters, as specified in DOE Permit No. 8033, Section 52." Monthly reports to BLM in 1997 did not provide this monitoring data (see Response 1-67). The ROD requires, " Mine water that is not used within the mine will be discharged from the portal to the infiltration pond. This discharge is regulated by WDOE Permit No. 8033. The portal discharge will be intermittent, and shall be monitored using a totalizing flow meter. Meter readings and field water quality parameters shall be recorded three times each week. During the periodic monitoring of the infiltration pond, the observed water level shall be recorded and accumulated sediment shall be removed as necessary to maintain the volume and infiltration capacity of the pond, as specified in WDOE Permit No. 8033. Water quality measurements shall be collected at the point of discharge to the pond if no water is present in the pond. Otherwise, the water quality measurements shall be obtained by collecting a sample of the standing water in the settling or infiltration ponds. Sampling shall be collected monthly for laboratory water quality analyses. The samples collected shall be analyzed for total recoverable metals, major ions, nitrate/nitrite, and total suspended solids (TSS). In addition to the listed parameters, water from the portal or infiltration pond shall be analyzed monthly for oil and grease. Collection of additional samples by Echo Bay may be required as determined by the Authorized Officer, BLM, from internal mine sumps during those intervals when there is no discharge to the surface." After discussions with EBM about this deficiency, the June 12, 1998 Lamefoot Mine Addendum to the 1997 Cumulative Trend Analysis Report of Water Quality Data" retroactively identified that 2,427,500 gallons of mine water had been discharged to the infiltration pond during 1997, but EBM still has not provided water quality monitoring data for those discharges. Available data supports the quoted conclusion (see Responses 1-50 and 1-53) and failure to provide data in accordance with the RODs would involve noncompliance. Since LF-8 is on the west side of State Highway 21, it can be concluded that the nitrate plume is moving toward the lake from the source (i.e., the mine facilities).
Page 30, first column: "The table identifies the relative decrease in concentrations that might be possible with simple dilution depending on amounts of mine water discharged, but is not intended to be predictive since the amount of discharge cannot be accurately predicted. " Table 10 is speculative and not based upon the extensive studies which have been done regarding water quality at the Lamefoot Mine. This table and discussion essentially states that the mine will have a discrete flow of 18	1-57	1-57: To the best of BLM's knowledge, there have not been any "extensive studies" of dilution by EBM or its consultants, especially for direct release of mine water through a borehole (see Responses 1-41, 1-42, 1-43).

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water from the mine that would be considered a discharge. The definition of a discharge and the assumption that a discharge would occur are inappropriate. If water flows from the mine in a diffuse manner as predicted by the models, there will not be a discrete flow and the dilution calculations would be inappropriate. The flows indicated for dilution are significantly less than would be expected since the flows that are reported for Wolfe Camp Creek are just the surface expression of a fraction of the flow that occurs in the alluvium, and the volume that would be available for dilution. There are numerous parameters in this table that vary significantly, including the flows in Wolfe Camp Creek, the water quality and particularly the outflow rate from boreholes. Too many variations are possible using this scenario to make this an appropriate presentation for an EA. In short, the table and discussion are entirely unreliable.	1-58	1-58: EBM correctly interprets the meaning of Table 10 which refers to outflow through boreholes without grouting (see footnotes), and not diffuse flow. If there is an ungrouted borehole connected to the surface, there can be a discrete discharge of mine water (see EA p. 24). The June 1998 supplement to the "Impact Evaluation" notes on p. 12 that, "Observed flow at the Wolf Camp spring averages 17 gpm, with a range from 90 gpm to 2 gpm". Adrian Brown Consultants' April 23, 1998 "Response to Comments By BLM On Lamefoot Incremental Expansion" postulated that possible differences in infiltration calculations "might include leakage past this location in a deep gravel infill in the streambed carrying the "missing" water." However, there has been extensive drilling in the Wolf Camp valley and EBM did not provide BLM with any data for the 1994 FEISS, the 9/20/95 EA or the current EA substantiating such a theory. Table 10 provides a means to identify the reasonably foreseeable possible adverse impacts in accordance with 40 CFR § 1502.22 based on currently available information. The terms discharge and outflow were both considered and both have some application here (see EA page 24). Although numerous definitions exist, the "Glossary of Geology, 1987" defines discharge as "the rate of flow at a given moment, expressed as a volume per unit of time", while outflow is defined as "water that flows out; e.g., groundwater seepage and streamwater flowing out of a drainage basin." The range of possible dilution for diffuse flow is shown in Tables 8 and 9.
Page 41, Section 6.8.1, third paragraph: "If mitigation described in the FEISS, 9120195 EA and the 11130194 and 9120195 RODS is not carried out, and impacts to water resources and drinking water supplies develop and are not mitigated, a large number of people could be effected [sic] and the result could be reduced use of recreational resources as described in Section 6.7. " This statement assumes that water quality impacts are tied directly to proper implementation of BLM specified mitigation. Further, this statement implies that any negative change in water quality is the result of allegedly improper implementation of mitigation measures such as grouting. As stated previously, grouting as environmental mitigation in the manner specified by BLM here is unprecedented. Any effects on water quality that are attributed to grouting in the future would therefore be purely speculative. The consultants have stated their belief that grouting will have no impact or a negligible impact on water quality. Other mitigative measures cannot be tied directly to changes in water quality.	1-59	1-59: See Comments/Responses 4-2 and 4-4 in which EBM's grouting specialist acknowledges concurs that grouting can reduce flow. Adrian Brown Consultants have acknowledged that grouting can prevent direct discharge through a borehole (see Comment/Response 1-41).
Page 26, third paragraph from the top, last sentence: "If the mine cannot refill above this level, the crown pillar would remain exposed and water quality within the mine workings would continue to decline. " The statement is incorrect. Pyrite oxidation could occur, but the excess NP of the rock would neutralize all the acidity that could be generated from the crown pillar, even under the most extreme circumstances. See October 9, 1997 Schafer memoranda (discussed above).	1-60	1-60: BLM disagrees. EBM's position is not corroborated by the 1995 testing and 1997/98 modeling which indicate that the long term prediction is neutralized ARD which does impact water quality, particularly with increased sulfate. The June 1995 "2750 Level" Report states on page 4-30, "The production of any acidity is expected to occur in localized fractures near the top of the mine (oxidized zone) where water is present, and to be neutralized within the mine workings." (see Responses 1-5, 1-11, 1-14, 1-15, 1-17, 1-24, and 4-3). The 1998 "Impact Evaluation" Table 3.3 shows that water quality may decline relative to upgradient and downgradient water quality. Even if mine water eventually approximates pre-mining water quality after a period of decades, such water would not be acceptable for rapid discharge through ungrouted boreholes and fractures without mitigation. However, if discharge is more diffuse and gradual as modeled, then external water quality may approximate modeled predictions as adjusted in the EA for dilution.
V. MITIGATION Echo Bay fears that the 1998 EA's numerous overstatements of the alleged adverse environmental impacts at the Lamefoot Mine may be used by BLM to justify imposing unnecessary and costly further mitigation measures. We urge BLM to reconsider the following mitigation measures. Page 44-45, New Monitoring Wells And Sampling Sites: The existing network of over 20 monitoring locations that surround Lamefoot should be more than	1-61	1-61: Additional monitoring beyond that of the existing network is needed to verify potential outflow pathways, drawdown impacts, potential sources of nitrate discharge, and postulation by the consultants about the effect of Curlew Lake fault on groundwater movement. Data has not been consistently collected from all wells in the existing monitoring network, impeding interpretation of background water quality and the flow system. Regardless of the number of existing monitoring sites, the conceptual model of the flow system developed by EBM and its consultants still needs some resolution and verification. The conceptual model has been developed from existing water data, geology and the assumptions in the numerical model. Some of the monitoring sites are needed to corroborate EBM's conceptual model, and the new stations are needed to prepare for long-term monitoring for potential post-closure impacts.

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adequate to monitor the minimal impacts that the consultants concur the project might produce even under the most extreme circumstances. New monitoring sites should be restricted to the four water monitoring sites that have been proposed by Hydro-Geo which address the concerns identified by the BLM review team (SP2, SP3, LF15 and LF16). The seven additional water sample locations(wells, wetlands and piezometers) suggested by the 1998 EA are to be added to a dense network of more than 20 monitoring sites that currently surround the area. These seven additional wells are plainly excessive. Installation of more wells with a more thorough (and costly) testing program will not materially improve BLM's understanding of the hydrologic conditions. The additional wells will likely reveal variable background conditions or impacts that are unrelated to mining.	1-61	1-61: The monitoring wells and surface water stations were intended to fill gaps in the identified original network. The individual stations are located within potential future impact areas with corresponding upgradient sites for data verification, or they are needed to corroborate EBM's postulated barrier to water movement (i.e., Curlew Lake fault).
It is important to emphasize that two deep groundwater wells recently were installed by Echo Bay in 1997 in the North Lamefoot area (LF13 and LF14) in anticipation of a request from the BLM for monitoring sites to address impacts associated with the possible North Lamefoot expansion. See North Lamefoot Hydrogeologic Study, Echo Bay Minerals-Kettle River Operations, Lamefoot Mine, Republic Washington, Hydro-Geo Consultants, Jan. 10, 1997. Echo Bay installed the wells in order to facilitate the permitting needs by initiating the collection of the requisite groundwater baseline data in a timely manner. Therefore, the four monitoring sites that were later proposed by Hydro-Geo in the May 1998 Impact Evaluation are in addition to the two deep wells installed in 1997. These four sites were offered to monitor locations that the BLM review team identified as critical. The addition of seven more sites (for a total of 11 proposed new monitor locations in this 1998 EA) is excessive. Furthermore, the seven additional wells proposed by the BLM were not presented for review prior to the publication of the EA.	1-62	1-62: At the time of EBM's proposal for LF 13 and LF14, EBM was advised that the wells were needed to monitor existing operations and the 2225N exploration drift EBM had proposed, and not solely for the possible North Lamefoot mining operations. The need for those wells has since been corroborated by their detection of sudden drawdown impacts associates with exploration boreholes from the drift, and the subsequent drawdown by the 2225N drift itself. The other monitor well locations have been discussed with EBM and its consultants since November, 1997. In a March 1998 meeting with EBM and TRC Hydro-Geo Consultants in Denver, CO, BLM discussed Hydro-Geo's proposed locations (LF 15, 16 and SP 2 and 3) and BLM 's proposals for LF 18, 19 and 20. The LF 17 location was identified in April based on the 1998 "Impact Evaluation". From April through June, EBM was advised again of each of the proposed locations on several occasions. BLM and EBM will evaluate the overall network again following mine closure as part of the post-closure evaluation comprehensive summary reports can examine options for optimizing the long term network at that time.
It must be remembered that the site is relatively small (even in relation to most gravel pits) and would encompass about 50 acres if constructed as an open pit. The consultants continue to emphasize the minimal risk that the site poses to the hydrologic regime. The minimal risk assessment is strongly supported by the water quality data that have been collected from the monitoring network since the exploration phase and reported in the 1995, 1996 and 1997 "Cumulative Trend Analysis Reports of Water Quality Data for the Lamefoot Mine." The monitoring sites proposed in the 1998 EA (beyond those four proposed by Hydro-Geo) will cost of over $225,000 to construct and install, with substantial annual data collection and analytical costs. This is an excessive financial burden in the context of the miniscule risks posed by this mine.	1-63	1-63: The magnitude of potential water quality impacts are described in EA Sections 6.2.1.5 and 6.7. As noted by EBM's monitoring consultant, EnviroData Solutions, Inc., "Until the mine refills post mining, there is no hydraulic head to push water out of the mine towards the wells." (Comment 6-3), "Furthermore, the mine is dewatered during mining so the mine would not be expected to be a source of outflow. It will not be until post mining when the mine refills with water that the seeps could register changes in water quality due to mining." (Comment 6-5) As a result, the water quality data from most of the monitoring sites currently amounts to background data for baseline water quality determinations and those sites will not likely detect any impacts until after the mine refills. The sites most likely to detect water quality impacts during operations are those immediately downgradient from the ore and waste piles, infiltration pond, septic system and other surface facilities related to the mine. As noted in EA Section 6.7, the potential impacts can be controlled by the mitigation measures but they are not miniscule given the number of people that could be affected. Potentially, drinking water quality could be affected for up to 97,000 visitors at the State Park and Curlew Lake resorts. The "EPA Quality Criteria For Water, 1986 (EPA 440/5-86-001)" noted that in "wells in which sulfates ranged from 1,000 to 1,500 mg/l, 62 percent of the respondents indicated laxative effects associated with consumption of the water. However, nearly on-quarter of the respondents ... reported difficulties when concentrations ranged from 200 to 500 mg/l (Moore, 1952). To protect transients to an area, a sulfate level of 250 mg/l should afford reasonable protection from laxative effects."
Additional details regarding the proposed surface water and groundwater sampling system are addressed in the comments by Dr. John Woodward of EnviroData Solutions, dated August 14, 1998, which are submitted herewith.		

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Page 45, Wetland #1 and Wetland #2: Monitoring wetlands for a full suite of water quality parameters is inappropriate and costly. The water quality in this type of wetland is extremely variable. Analytical results from these sites would indicate a large degree of variability that mistakenly could be attributed to mining.	1-64	1-64: Adequate monitoring would establish the degree of variability and enable direct identification of impacts. After a background water quality is established, monitoring should be able to distinguish between natural variations and impacts due to mining.
Piezometer recommendations: Piezometers have historically been used to monitor water levels, not water quality. We see no basis for expanding the role to include water quality monitoring in the absence of any evidence of a water quality problem.	1-65	1-65: Piezometers identified in EA Section 6.13.2. item 2 are only intended to monitor water levels, not water quality. With regard to piezometers, item 2 only pertains to the frequency of water level measurements to be taken at each station. Piezometers would be monitored at the same frequency as the monitoring wells, i.e., monthly for at least twelve consecutive months. After the initial twelve months of measurements, a determination would be made on adjustments to the monitoring schedule to a less frequent interval, e.g. quarterly.
Page 45, Item 2: "After the initial monthly sampling period, a determination would need to be made on whether intervals could be increased to quarterly sampling." The expert consultants should participate in the discussions with BLM regarding any further sampling that will be conducted.	1-66	1-66: BLM agrees.
Page 46, Item 6, last sentence: "Data would include records of water discharge quantities from the mine portal, regardless of the disposal location, and the water quality test results for that water." This information is not relevant to this process. Mine water is considered process water while in the mine and is classified as waste water by the DOE once it is removed from the mine. The quality of this water is germane only to the water user and has no relevance to the regulatory community unless it is discharged from the site. Water quality testing will be determined by the DOE at the point that is specified as the discharge location. Echo Bay will comply with DOE requirements regarding water testing and reporting as specified in the DOE Wastewater discharge permit for the Kettle River Operations.	1-67	1-67: See Responses 1-53 and 1-56. This is a requirement of the 11/30/94 Record of Decision. Section IV.E.3.e., explicitly requires that, "Operational monitoring results shall be reported to the WDOE and the Authorized Officer, BLM on a monthly basis." Under 43 CFR §3809, EBM is required to comply with the 11/30/94 Record of Decision, and not just with the requirements of the WDOE. Quality of water discharged from the mine is clearly relevant to mining impacts, as documented in the FEISS. "Operators conducting operations under an approved plan of operations who fails to follow the approved plan of operations may be subject to a notice of noncompliance." 43 CFR §3809.3-1(2). Also, "All operators shall comply with applicable Federal and State water quality standards, including the Federal Water Pollution Control Act, as amended (30 U.S.C. 1151 et seq.)." 43 CFR 3809;2-2(b).
Page 46, Item 8; Grouting: "Complete verification inspections of grouting of all past surface and underground boreholes and provide updated reports to BLM." Verification inspections for grouting were not required until issuance of the 11/30/94 ROD. Grouting that was conducted prior to 11/30/94 did not require complete verification inspections. As BLM knows, a substantial controversy arose in 1998 between Echo Bay and BLM regarding the interpretation and application of the 1 gpm standard for grouting. The 1998 EA raises further serious operational concerns for Echo Bay. In particular, the statement (at p.32) that "grouting ... [should be] carried out in advance of stoping. . ." so that "fractures would be sealed before the area is mined. . .," is especially troubling to Echo Bay's mining engineers in light of the recent controversy with BLM regarding the (stringent interpretation of the 1 g.p.m. grouting)standard. Echo Bay remains willing to carry out a grouting program for significant fractures and boreholes, notwithstanding the doubts about the effectiveness of grouting as described above in these comments. However, it is imperative that the details of a grouting program be developed jointly by Echo Bay hydrogeologists and mining engineers together with BLM technical staff to ensure that grouting requirements do not render mining operations technically or economically infeasible.	1-68	1-68: The current grouting measures in the Plan of Operations describe the general methods and procedures for grouting but do not give any details on when, where or how grouting would actually be conducted for specific areas. BLM agrees that an actual grouting program is needed identifying where grouting will actually take place within the mine, both for existing mine workings and for new mine expansion areas. This grouting program should be integrated with the mining plan to ensure not only that grouting is conducted concurrent with mining in accordance with the 11/30/94 ROD and the approved Plan of Operations, but also that the grouting is scheduled in advance and carried out in a manner that minimizes conflicts with other activities. EBM has had four years to develop such a program, but as yet has not done so. BLM would certainly work with EBM and its consultants if they develop a grouting program, but regardless, grouting must be performed.

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Accordingly, we propose that BLM require as a condition in the ROD that Echo Bay submit a comprehensive grouting report and plan within forty-five days after approval of the pending mining plan of operations. The ROD would further require Echo Bay representatives and BLM staff to meet within thirty days to review that plan, and Echo Bay would be required to submit a final grouting report and plan for BLM's approval within thirty days after receiving BLM's comments on the grouting report and plan. This approach should resolve BLM's concerns without any risk to the environment in the short term and without jeopardizing Echo Bay's continued mining operations.	1-69	1-69: A comprehensive grouting report and an implementation program to carry out the ROD requirements would be desirable. However, it is important to note that ongoing grouting operations would need to continue concurrently in the interim. The general timeframes proposed are probably the minimum needed to jointly develop such a program. Past experience with EBM studies has shown that this may be an underestimate, particularly since EBM apparently has not yet developed a field program to analyze the fault, fracture and jointing systems (see Response 1-39). Counting the time stated by EBM, BLM's review time, transmittal of documents, and normal delays in arranging meetings, it could easily involve 5 to 6 months or more to develop the program. Since stopes are continuously being opened and backfilled, and the mine currently only has about one year of operations with current ore zones, and a maximum of about 2 years even with extensions, grouting needs to be taking place now. As noted in Response 1-68, BLM is willing to participate with EBM in this effort.
VI. MISCELLANEOUS COMMENTS Page 4, paragraph 5: The 1998 EA presents a discussion regarding the evaluations which were conducted on the mine and whether the scenarios which the B.M. required to be evaluated represented expected or conservative cases. The BLM-approved consultants authored a memorandum, dated May 11, 1998, which, "explains the conservative approach employed in the modeling of potential impacts associated with the proposed interim expansion at the Lamefoot Mine. The modeling assumptions and inputs are explained in relation to the actual site specific information and data collected via the current monitoring program." The memorandum proceeds to discuss in detail the hydrologic modeling that was employed, as well as the geochemical modeling and the impact evaluation that was performed. The consultants stated in summary: [H]ydrologic and geochemical modeling were performed in a conservative manner, utilizing conservative input values. The conservatism of the modeling effort is underscored by the fact that model flow values were higher and inflow water quality poorer than the values observed in the current monitoring program. This is especially true considering that the mine is currently dewatered and groundwater inflow and infiltration is entering the mine through a desaturated crown pillar, the conditions modeled for during mine filling scenario. These conditions will change negligibly as a result of the proposed interim plan.	1-70	1-70: This comment applies inconsistent logic and incorrect interpretation of the test results and data developed in 1994 and 1995. On one hand, the consultants strongly advocate that BLM should accept the results of their studies; on the other, they appear to expect BLM to ignore conflicting test results that don't support all the conclusions. The prediction of the studies is neutralized ARD. The comment is not "especially true", it is false. Both the FEISS and the June 1995 "2750 Level" report predict that there will be a long lag time after exposure of mine workings before water quality begins to degrade (see Responses 1-13, 1-24, 1-60). BLM agrees that there will be a long lag time for effects on pH to become evident due to the amount of neutralization capacity in the mine (see White, 1990; Response 1-6). This long lag time was demonstrated by testing of the "Old Timer's Adit" and comparison with mine workings that had only been open two years or less. Therefore it is inconsistent to base future predictions of effects on the current inflow water quality of mine seeps and imply that "conservatism ... is underscored by the fact that model ... inflow water quality is poorer than values observed in the current monitoring program." The conditions in the model will take years to develop. Furthermore, the current conditions are not those that will be present post-closure; at that time, the ventilation will be turned off, there will be high humidity, moisture and seeps on the walls, and pools of standing water throughout the mine. (see Responses 1-11, 1-17, 1-27, 1-38).
The argument put forth by the BLM that the evaluation is something less than "extreme" is particularly troubling considering that the original March 1998 submission for the Interim Mine Proposal was titled "Worst Case Impact Evaluation for the Proposed Interim Expansion for the Lamefoot Mine". In discussions with the BLM following publication of this document, the BLM asserted that the title was inappropriate. Echo Bay changed the title in an effort to expedite 22	1-71	1-71: See EA page 4. BLM has consistently advised EBM that this analysis was required to use all of the information, data and test results applicable to the site. That meant including information that might yield negative findings, and not simply focusing on the information that might suggest the most favorable results. Such an approach gives a more realistic appraisal of the potential for impacts and addresses simplifications and limitations inherent in the modeling process. BLM specifically advised EBM that a "worst case" analysis was neither requested nor desired. Merely titling a document "Worst Case" does not mean that the analysis actually involves a worst case and doing so simply gives an erroneous impression of the study. However, under 40 CFR § 1502.22 please note that the definition of "'reasonably foreseeable' includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason." As such, even an "extreme" analysis would be well within the purview of NEPA and the FEISS.

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the review, but we maintain our belief that the impact evaluation presents an extreme worst case evaluation.		
The BLM states in this paragraph that 'it is less likely that all of these conditions would occur simultaneously to the degree indicated. . . . " 1998 EA at 4. However, that is precisely the conditions under which the model was run. Therefore, this paragraph seems to contain a very well stated admission that the model present an extreme model since, as the 1998 EA acknowledges, it is highly unlikely that all the parameters which are included in the evaluation would ever occur at the same time. Yet, the paragraph does not concede that the modeling was "extreme".	1-72	1-72: The intent of a model is to use acceptable scientific methods to provide an overall integration and interpretation of data to identify the approximate nature of impacts. The very nature of modeling requires substantial simplification of natural processes. As a result, models omit some information, they cannot model all possible variables (e.g., the specific effectiveness of ARD control measures), and each type of model places emphasis on different factors and processes. In addition, different types of models have different limitations, but none of the models gives a perfect representation of real life. Steffen Robertson and Kirsten, 1989, note, "An inherent weakness of predictive testwork is the required extrapolation to predict impacts after years of mine operation from relatively short-term test. This is particularly critical where acid-forming rock has significant levels of both solid-phase sulfphide and solid-phase carbonate so that drainage from the rock may remain pH-neutral for many years before becoming acidic.". They state, "In general, three sources of uncertainty in model prediction arise: incomplete or invalid model structure, inherent parameter bias or variability, lack of parameter calibration and model verification." Models are validated against a range of sites to verify that they are capable of evaluating specific processes in the manner intended. Validated models are then calibrated against site specific conditions and verified for use at those specific sites. In general, validated predictive models for mine geochemistry and groundwater movement associated with mining are least accurate in situations such as the Lamefoot Mine where there is little or no past historical data for calibration based on actual refilled mine workings, whereas the same models would be most accurate when there is substantial past data for calibration (e.g., a closed mine with a refilled pit and years of monitoring data). It is not uncommon at mine sites, e.g., pit filling models, to re-run models for calibration revisions over a period of years as new monitoring data is obtained. It will not be possible to verify the water quality and flow modeling against actual refilling data at Lamefoot Mine until after mine closure, so uncertainty in applicability of the models and accuracy of model predictions will remain.
Paragraph 6, sentence 3: "[E]ven the remotest [sic] possibility of acid mine drainage affecting Curlew Lake and domestic wells is unacceptable and would be regarded as unnecessary or undue degradation to the environment." This sentence excerpted from the 1994 ROD conflicts with the allowance in the 43 C.F.R. Subpart 3809 regulations and the Federal Land Policy and Management Act ("FLPMA"), 43 U.S.C. § 1732(b), for some necessary and expected degradation from mining. BLM does not have authority to regulate mining to prevent all remote possibilities of any impacts.	1-73	1-73: Mining has obviously resulted in impacts within the project area. Necessary and expected degradation within the project area was authorized under the RODs and has occurred, e.g., roads, drill pads, ore and waste rock piles, underground excavations. However, with regard to water quality, the constraint is to prevent impacts outside the project area as analyzed in the FEISS, not to prevent all impacts.
Page 10, paragraph 1, sentence 3: "[U]nder the law and regulations, mining activities are not discretionary actions under NEPA. Acceptable impacts include the reasonable and necessary degradation associated with the necessary disturbance required for the extraction of minerals within authorized areas." This is a correct statement of the law, and it conflicts with the above -referenced declaration that Sseven the remotest [sic] possibility of acid mine drainage affecting Curlew Lake and domestic wells outside the project area is unacceptable ..." The full citation from the 1994 ROD (page 32) is: Additional studies have been requested because even the remotest possibility of acid mine drainage affecting Curlew Lake and domestic wells outside the project area is unacceptable and would be regarded as unnecessary or undue degradation to the environment. However, if the additional data gained from these studies corroborates the predicted low impacts identified in the FEISS for full mining as Echo Bay initially proposed, additional plan modifications would be considered focusing toward full development." (Emphasis added.) The "additional studies" that have been conducted since issuance of the 1994 ROD (most notably the 1995, 1997 and 1998 impact evaluations) clearly demonstrate that the mine will have extremely low impacts.	1-74	1-74: Additional studies were conducted in 1995 and additional mining was analyzed in the 9/20/95 EA and authorized in the 9/20/95 EA. However, subsequent monitoring and analysis identified that the data and projections used in the 1995 studies were not entirely accurate, and a number of the modeling approaches used by EBM did not appear to accurately represent the mining operations, mine site conditions, and other factors (see EA Sections 1.0, 2.0 and 6.5.1). Therefore, in 1997, BLM required that the 1995 analysis be re-run using all the current information and assumptions that more accurately reflected the expected site conditions.
Page 13, paragraph 2, sentence 5: "since mine workings have substantially increased in size since then, the moisture loss from ventilation may have increase to	1-75	1-75: The June 1995 "2750 Level" Report, Appendix A, page 24 described the ventilation tests to measure evaporation. "(T)he evaluation was conducted during a period when no other activities were being conducted in the mine, and during a period when the entire ventilation system was turned off." and "the ventilation at the time was from natural convection)". Factors measured in that study included air temperature, air flow rate, and humidity at several locations within the mine. The testing took place in December, one of the months with the lowest amount of water inflow, to evaluate the amount of evaporation under conditions of minimal water inflow. Mining had not started at the time of the testing, so mine workings were limited to just the exploration drifts and there were no large surface areas exposed in stopes.

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about 2 gpm or more. " There is no basis for this assumption. There are no studies or measurements which might indicate that this value is accurate.	1-75	1-75 (contd.): Even a general approximation shows a major increase in surface area. There were only about six sizable drift levels between elevations 2940 ft. and 2615 ft. in 1994, and they only averaged about 1040 ft. in length each, with the levels totaling about 6240 ft. in length.. Excluding the main portal adit, the longest drift was about 2100 ft. length and the shortest was about 775 ft. The southern ends of drifts ranged from about 25825N to 25900N, and the northern ends ranged from about 26600N to 27512N. By comparison, current mine workings include 16 main levels from elevations 3145 ft. to less than 2138 ft. elev. (approx.). The original six levels have been extended an average of about 195 ft. each (about 19% alone), and there are ten additional levels averaging about 612 ft. each. Levels now total about 13516 ft, or about a 217% increase in the lengths of levels. The number of drifts per level varies, and stoping has opened numerous large cavities within a zone that extends about 410 ft. high and about 1590 ft. long, exposing a large amount of surface area. The amount of evaporation is related to the amount of surface area exposed, so under similar conditions and given the increase in the size of the workings, it is inconceivable that the evaporative loss is not substantially more than 1 gpm; if anything, 2 gpm is the minimum average amount of loss. EBM is welcome to re-run the tests under similar conditions to identify the precise amount of evaporative loss, since that would bring the current inflow values closer to the modeled values.
Appendix A. Appendix A purports to summarize and compare the key conclusions from the 1994 FEISS, the 1995 impact evaluation (2750 Report), the 1995 EA, the 1998 impact evaluation and the 1998 EA. Consistent with the general points made above in these comments, Echo Bay disagrees with many of the characterizations contained in the summary, but we believe that it will not be constructive to specify each point of dispute in the appendix.	1-76	1-76: EA Appendix A is a revised and updated version of a comparison that was made in 1995 as part of the technical review of the June 1995 "2750 Level" Report, the July 1995 "Impact Evaluation" and other technical documents prepared for the 9/20/95 EA.
Mine Survey Boundaries. In the ROD which is issued approving this pending plan of operations, BLM must recognize that mine boundaries are in a constant state of flux. Subsurface mine boundaries must have the flexibility to change according to the most recent drilling information. Mine boundaries that are defined by pre-mine survey limitations only provide a "best-guess" of mine boundaries. BLM's authorization of further expanded mining activities must take account of this reality and not unreasonably constrain Echo Bay's ability to mine. We would be pleased to review this issue further with BLM staff at a face-to-face meeting.	1-77	1-77: BLM agrees that mine boundaries would normally be expected to vary throughout the life of operations. However, at Lamefoot Mine, EBM was adamant during the FEISS process that the mine boundaries be restricted to the zones in the original proposal. As a result, while the mine boundaries may need changes during the course of operations, environmental reviews of all expansions outside that area are constrained by the mining boundaries analyzed in the FEISS. Absent a supplemental EISS, expansions are constrained to take place within the extent of mitigated potentially significant adverse impacts identified in the FEISS. Each expansion must be analyzed in comparison to the mitigated potentially significant adverse impacts and mitigation in the underlying analysis in the FEISS and 11/30/94 ROD. EBM was informed in 1993 and 1994 that EBM's choice to constrain the FEISS could result in future constraints on the flexibility of environmental reviews and decisions for future expansions, but EBM chose to restrict the scope of the FEISS. EBM's choice allowed EBM to start mining operations quickly in 1994, but it has added difficulties for subsequent environmental reviews.
VII. CONCLUSION Echo Bay wishes to work cooperatively with the BLM to promptly resolve these significant issues. We fully agree with the proposed finding of no significant impact published in the July 30,1998, notice. We urge BLM to issue a ROD with reasonable mitigation conditions which are appropriate for the minimal environmental risks present at the Lamefoot Mine. 24		

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Schafer & Associates, Inc. 865 Technology Blvd (406) 587-3479 P.O. Box 6186 FAX (406) 587-0331 Bozeman, MT 59718 MEMORANDUM DATE: August 13, 1998 TO: Steve McIntosh, Echo Bay Minerals Co. FROM: Ed Spotts and Dr. William Schafer, Schafer & Associates RE: Comments on July 1998 Lamefoot Mine Environmental Assessment This memorandum provides our comments on the on July 1998 Lamefoot Mine Environmental Assessment (EA) prepared by the Bureau of Land Management (BLM). Our comments focus primarily on the technical issues related to the geochemistry and water quality sections of the document. We provide both general comments and comments related to specific portions of the EA text. The reader is encouraged to review, and we offer for the record, our memorandum dated October 9, 1997. This memorandum provides our responses to BLM comments on the 1997 impact evaluation report and addresses many of the technical issues which are relevant to this EA. Additionally, pertinent information is also present in a technical memorandum addressing the ability of backfill to neutralize acidity (October 9, 1997) and a report on the use of replacement backfill (July 1995). COMMENTS Overall, we agree that a Finding of No Significant Impact (FONSI) is appropriate for the Lamefoot Mine. However, we are concerned with some of the general and specific issues presented in the EA. The general tone of the text is presumptive and implies that the formation of acid rock drainage (ARD) is likely and only requires a lag-time until it occurs. This is particularly true with reference to the crown pillar. These statements are unsubstantiated and clearly not supported by. the hydrologic and geochemical studies and modeling. The site geology, geochemical test data and monitoring results clearly indicate that the mine is a well-buffered system which has ample neutralization potential to preclude the development of ARD. Similarly, the term "acid generation' is often used where the term "pyrite oxidation" would be more appropriate.	2-1	2-1: See Responses 1-5, 1-11, 1-14, 1-15, 1-17, 1-24, 1-60, 1-70 and 4-3. The testing performed in 1994 and 1995 indicates that there will be a long time until ARD develops, but that it will eventually take place if the crown pillar remains exposed. This is also noted in the June 1995 "2750 Level" Report, which states on page 4-30, "The production of any acidity is expected to occur in localized fractures near the top of the mine (oxidized zone) where water is present, and to be neutralized within the mine workings." The June 1995 "2750 Level" report's conclusions about long term control of ARD were based in part upon the prediction that the mine workings would completely refill with water. Chapter 5, item 2 of the report notes that, "After closure of the mine, groundwater inflow will fill the mine in about 50 years. This refilling will resaturate mine voids and the surrounding rockmass to the original water table, which is observed to be within 20 feet of the surface in the mine vicinity. This will deny oxygen to the remaining sulfide materials, extinguishing any acid-generating reactions which may have initiated in these materials. Sulfide oxidation will at that time return to the natural (pre-mining) rates, which are very low. Accordingly, very little ARD is expected in this mine, and only natural rates of sulfide oxidation are expected after the mine refills with water." (emphasis added). Subsequent studies and models in 1997 indicate that the mine may not refill completely, leaving the crown pillar perpetually exposed to oxidation of sulfide materials. Referring to pyrite oxidation as described by the comment is technically accurate but misleading. It is generally accepted that pyrite oxidation results in the generation of acidity which may or may not be counteracted by neutralizing reactions. Williams, 1975, stated, "Acid mine drainage is usually formed by the chemical reaction of oxygen (in air), water, and iron sulfide - principally pyrite (FeS_2)...When the iron sulfide is exposed to oxygen, it is converted by oxidation to sulfuric acid and compounds of iron. ... The ferric ion can, and does, react with iron sulfide , whereupon additional sulfide is converted to sulfate, thereby accelerating formation of acid. ... Pyrite oxidation and subsequent transport require only a small amount of water and air." (emphasis added). Lapakko, 1997, states, "Acid is produced as the result of the oxidation of iron sulfide minerals" (emphasis added) and Deutsch, 1997, notes "This reaction shows that in the presence of molecular oxygen Fe(II) and S_2(-II) in pyrite are oxidized by O_2 ... The release of hydrogen with a strong acid anion (sulfate) results in an acidic solution unless other reactions occur to neutralize the hydrogen ions." (emphasis added). Steffen Robertson and Kirsten, 1989, state, "The first important reaction is the oxidation of the sulphide mineral into dissolved iron, sulphate, and hydrogen (H^+) ... The dissolved Fe^{2+}, SO_4^{2-}, and H^+ represent an increase in the total dissolved solids and acidity of the water, and unless neutralized, the increasing acidity is often associated with a decrease in pH." (emphasis added). Acid generating reactions occur and they take place concurrently with neutralizing reactions. As noted in Response 1-19, the overall prediction for the Lamefoot Mine is neutralized ARD.
A substantial effort was put into performing and presenting in the EA an analysis of the effects of dilution on constituent concentrations. For the most Environmental Solutions for Water, Waste, and Land	2-2	2-2: See EA page 2 regarding, noting that the consultant's views differ from BLM's view on the extent of conservatism involved in the models. See Responses 1-43, 1-57, 1-58: EBM and the consultants were invited to provide a quantitative analysis of dilution to substantiate their conclusions in the 1998 "Impact Evaluation", but that analysis was not forthcoming. BLM used available analyses and data to calculate the approximate magnitude and range of effectiveness of dilution, and to evaluate the potential impacts in accordance with 40 CFR §1502.22 requirements to address the potential reasonably foreseeable significant adverse impacts.

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part, this effort addressed hypothetical situations, used conservative model output values and did not adequately or quantitatively address the volume of flows which would be involved.		
Finally, it would be prudent to use the results of the most recent 1998 Impact Evaluation in the interpretation of the effects of mining on water quality. Although it is conservative in nature, this modeling effort incorporates the most recent hydrologic model inflow estimates and presents a more sophisticated approach of addressing metal sorption reactions than 1995 modeling efforts.	2-3	2-3: BLM agrees. The 1998 "Impact Evaluation" modeling is the primary version relied on for the environmental review. However, other earlier models were also considered in the analysis.
Specific Comments		
Page 17, section 5.3, P2 - Based on NNP data, the altered limestone lithology has a mean NP/AP ratio > 3, although some samples had negative NNP values and ANP/AGP ratio < 3.Although altered limestone samples classified as potentially acid generating produced appreciable sulfate levels in humidity cell tests, pH values remained neutral. Therefore, the classification of all altered limestone as PAG waste is misleading. This is especially important in that this lithology comprises a portion of the crown pillar, which is referred to as having acid generation potential throughout the EA. In geochemical modeling, the actual mean NNP value of all altered limestone samples was used to characterize this rock type.	2-4	2-4: See Responses 1-5, 1-11, 1-14 and 1-19. A number of kinetic tests were cut short due to time constraints rather than run them until neutralization potential was consumed by sulfide oxidation reactions. The fact that the tests clearly showed that sulfide oxidation continued unabated through the end of the test was an indication that they might eventually generate net acidity and a corresponding pH decline. As a result, sufficient information had been obtained from the tests to determine that the samples were potentially acid generating. As noted in Response 1-19, the NNP values of altered limestone span a wide range. The average NNP value of the entire altered limestone lithology does not represent the actual character of the portions with higher sulfide contents, although it does indicate that the altered limestone tends to have a greater amount of neutralizing capacity that will take longer to consume. As found in a study by White, 1992 (Response 1-14), short term kinetic tests are not definitive, e.g., "If kinetic tests...had been terminated at 20 weeks, as has been common practice, the sample could have been mis-classified as non-acid producing."
Page 17, section 5.3. P3 - This paragraph references a long lag-time before neutralizing materials are consumed by acid-generating reactions. Because pyrite oxidation rates were moderate to slow and the vast majority of material has an excess of NNP, there will be ample NNP to neutralize any acid produced, even accounting for coating of limestone, as shown in geochemical modeling of backfill (October 9, 1997 Technical Memorandum to Echo Bay).	2-5	2-5: BLM concurs that neutralized ARD is the most reasonable prediction for the overall mine for the quantities and types of rocks involved, considering the neutralizing potential of the rocks and the mitigation measures. However, the neutralization potential will not stop sulfide oxidation. See Responses 1-13, 1-17, 1-19, 1-24.
Page 18, section 5.3. P 1 -This paragraph implies that oxidation of pyrite along fractures will lead to acid generation which will increase over time. Again, there is ample NNP to neutralize acid produced as water moves through bedrock. This is evidenced in the results of the drip survey, which shows that the vast majority of water entering the mine is neutral to alkaline. Page 18, section 5 .3, P7 - This comment again refers to the consumption of neutralization potential by acid producing reactions. Because there is excess NNP, conditions will remain neutral.	2-6	2-6: The presence of neutralizing material does not prevent pyrite oxidation and acid generation from occurring or increasing (see Response 1-11). The presence of a large amount of neutralizing capacity mainly serves to neutralize acidity as it is generated, although in some instances it can reduce the amount of pyrite oxidation, such as the control measures employed required by the ROD mitigation (see Response 1-28). The current water quality of seeps in recent mine workings is not indicative of future water quality because there will be a long lag time before effects become evident (see Responses 1-14, 1-24, 1-28). BLM concurs that the prediction is neutralized ARD, but that still results in effects to water quality in the mine that could potentially impact areas outside the mine (see Responses 1-19, 1-28, and 1-60).
Page 19, section 5.3, P1 -This text describes the amount of "PAG" backfill in the mine. It should be clarified that these estimates assume altered limestone is PAG, even though NNP data show that overall, it is a neutralizing lithology. Additionally. backfill QA/ QC testing clearly shows that the vast majority (> 99%) of samples of backfill placed are neutralizing and meet ROD criteria (ANP/AGP > 3; NNP > 20 TcaCO3/kT). Actual QA/QC test data reveal that only appropriately 12,000 tons (1 % of 1.2 million tons) of waste rock backfill through June 1998 is classified as PAG based on the ROD numeric criteria.	2-7	2-7: See Response 1-5 and 1-19. As noted by Morin and Hutt, 1997, "Averaging data for a rock unit or minesite component gives the impression that it behaves as one homogenous unit, which is rarely true." The stated quantities are incorrect, use an improper method of calculation of PAG content, and give a seriously misleading impression about the nature of the materials involved. Whether rocks are considered to be PAG or NAG is determined on the characterization testing for individual lithologies and sulfide contents. Composited samples of blended backfill give an overall geochemical value for the mixture after crushing and testing. This only indicates the relative amount of neutralization potential added to the mixture and provides verification of whether blending proportions meet the ROD criteria with enough neutralization potential to offset any acidity generated. The purpose of blending is to emulate the NAG condition as a control measure for acidity, but the rock does not become NAG (see Response 1-5). See EA Table 1 for approximate PAG quantities for the proposals. are noted in EA Table 1. Total PAG tonnage was about 450,932 tons at the end of July 1998. See Response 1-21 regarding the sensitivity analysis for the model.

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Page 25, section 6.2.1.3. Table 4 - It is not clear if the 50XXX in reduction in mine inflows is predicted/calculated or assumed.	2-8	2-8: The 50 times dilution used in Table 4 was interpreted from existing data in the FEISS and 1998 modeling, using Adrian Brown Consultants' June 1998 supplement to the "Impact Evaluation" Section 4.2.1, which identified pre-mining flow through the mine area. Pre-mining flows were compared to pre-mining concentrations in groundwater to estimate dilution. The 50 times dilution appears to be a more likely level of maximum dilution than estimates presented in the FEISS. As noted in Table 8 footnotes, the previous estimate of 100 times dilution calculated by Woodward-Clyde Consultants appeared high, since a water balance for 100 times dilution would require more water adjacent to the mine than was projected for the entire 3000 acre model area based on 17 inches annual precipitation.
Page 27, section 6.2.1.5., P5 - It would be best to refer to the 1998 geochemical modeling, as the assumptions and approach take into account the most recent mine inflow predictions as well as a more thorough and sophisticated modeling of sorption reactions. Additionally, 1997 (October 9, 1997 Technical Memorandum to Echo Bay) modeling of backfill neutralization should be referenced as it provides a conservative estimate of the ability of backfill to neutralize acidity and accounts for passivation (coating of limestone) a range of pyrite oxidation and variable amounts of PAG backfill.	2-9	2-9: See Response 1-26; the memorandum mentioned is part of the 1998 "Impact Evaluation" report. Regarding the models, see Response 2-3; the 1998 "Impact Evaluation" report is the primary version relied on in the environmental review. However, as shown in EA Table 6, it is instructive to note that the 1995 and 1998 models yielded similar predictions regarding sulfate and manganese.
Page 27/28, section 6.2.1.5., P6 - As noted in the 1998 impact evaluation, sulfate and manganese concentrations are an artifact of the conservative input chemistry used in the model and the conservative behavior (i.e. non-reactive) of these constituents in the model. The 2750 report(1995) and 1998 impact evaluation both noted that over time, constituent concentrations would be expected to return to near pre-mining levels as upgradient water with lower concentrations moved into and through the mine area. Neither this situation nor any dilution was accounted for in the modeling. Thus, the values are conservative. The discussion of dilution using conservative model values throughout the text in this section is speculative.	2-10	2-10: Sulfate is a product of pyrite oxidation. Notwithstanding any artifact of modeling, the physical conditions after mining will be more conducive to sulfide oxidation than the conditions prior to mining. Prior to mining, the rock mass was essentially intact, discontinuities would have mainly involved joint and fracture surfaces, and the water level was within 20 feet of the surface, limiting the amount of exposure of pyrite to oxidation (see Response 2-1). After mining, the backfill will contain broken PAG rock fragments of various particle sizes ranging from finely crushed material up to cobble/boulder size, and the crown pillar and much of the pyrite-bearing backfill may remain perpetually exposed to oxidation above water level. The presence of neutralizing material does not preclude pyrite oxidation and the broken fragments of backill will have vastly more surface area exposure to pyrite oxidation than intact bedrock did prior to mining (see Response 1-11). As a result, it is reasonable to expect that a greater amount of sulfate will be released after mining than before mining, particularly with the crown pillar also being exposed to oxidation. Although sulfate concentrations within the mine may eventually decline as described in the comment, that decrease may take decades to centuries and will not likely diminish greatly until the levels of sulfate production are reduced by oxidation of the exposed pyritic materials (see Response 1-60). The June 1995 "2750 Level" Report, Chapter 5, concluded, "The water in the mine voids may ultimately contain ... elevated levels of sulfate." The July 1995 "Impact Evaluation" Best Case involved "high sulfate water" (page C-1). Even pre-mining sulfate concentrations would be unacceptable for direct release. Since the model did not account for dilution , it rendered the conclusions incomplete, so dilution was addressed in the EA (see Responses 1-17, 1-26, 1-58).
Page 28, section 6.2. 1.5, P 1 - This paragraph, as well as text throughout the document, refers to the reduction of outflow from the mine if grouting is performed. Ultimately, outflow must equal inflow (at equilibrium). Therefore, it is presumed that grouting will decrease inflow. However, if the relative amounts of inflow from lateral groundwater flow and recharge through the crown pillar remain similar under grouted conditions, inflow chemistry and thus mine water chemistry will be unaffected. Because the copious amount of limestone (calcite) in the mine area drives the equilibrium chemistry, it is unlikely that grouting will affect water groundwater quality in or around the mine.	2-11	2-11: Grouting is intended to control movement of groundwater (i.e., reduce both inflow and outflow of groundwater) by reducing the hydraulic conductivity of the zones grouted.
Page 28, section 6.2, 1.5, Table 7 - The table does not show the values calculated using 100 % of the laboratory measured attenuation. It is not clear to what footnote (**) is referring.	2-12	2-12: Footnote (**) in EA Table 7 indicates that the 1998 model predicts that mine water concentrations of cadmium, copper and zinc will meet State primary drinking water standards within the mine void (see Table 6). The July 1995 "Impact Evaluation" described the assumption that, "100% of the attenuative capacity identified in the attenuation testing is effective in the rockmass. This is equivalent to assuming that the attenuation in the real material occurs on the lining of the fractures. When the rock sample is crushed for the tes, the fracture lining is also crushed, and the attenuation which occurs is assumed to take place on that crushed fracture lining material, with minimal attenuation taking place on the fresh faces of the crushed material." (emphasis added). At the start of the 1997 modeling process, BLM/EPA advised Schafer & Assoc. that use of 100% attenuation was inappropriate because it pertained to laboratory conditions and was not a realistic or representative value for field conditions.
Page 29 - This page discusses the effects of dilution on constituent concentrations. Please refer to response for Page 27/28. section 6.2.1.5, P.,	2-13	
Page 29, section 6.2.1, P5 - This paragraph, as well as other text throughout the document, presumes the crown pillar will be acid-generating. Geologic (lithology), geochemical(humidity cells, NNP tests, scanning electron microscopy (SEM) analysis) and monitoring (drip and seep water quality) data clearly do not support this presumption. Geochemical modeling nonetheless used conservative input (inflow) chemistry to address this issue.	2-14	

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Page 31, section 6.2.1.5, P2 - It is not clear what additional monitoring is specifically proposed. The purpose and benefit of this monitoring are not stated or defended.	2-15	2-13: See Response 2-10. 2-14: See Responses 1-5, 1-11, 1-13, 1-14, 1-19, 1-23, 1-24, 1-25, 1-28, 2-4, and 4-3.
Page 31, section 6.2. 1.5, P3 - It is stated that mitigation provides for actions necessary to meet State water quality standards before discharge. However, on Page 15/16, section 5.1.4, P2, the text notes that natural background levels of TDS, sulfate, zinc, manganese, fluoride, arsenic, lead and iron exceed State numeric groundwater criteria. It is unclear if and why a more stringent value would need to be maintained in the post-mining environment.	2-16	2-15: The mitigation is identifed in the paragraph quoted - see EA Section 6.13. 2-16: As described in EA Section 6.2.1.3, mining may alter the local hydrology by creating new pathways (boreholes, mine workings) and connections that did not previously exist, by improving connections, and by altering the hydraulic conditions applied to new and old pathways. This could result in a release of mine waters to the surface by routes that did not exist prior to mining (e.g., new surface seeps) and such releases could likely exceed acceptable concentrations and cause impacts if not mitigated, especially if discharged is through an ungrouted borehole (see Responses 1-18, 1-60, 3-11, 3-18 and EA document 57).
Page 34, section 6.4.1, P4 - This comment points out that crown pillar subsidence and associated fracturing has likely occurred already and that these conditions could lead to increased pyrite oxidation rates. Similarly, they could lead to the contact of water with more neutralizing minerals. It is very important to point out that the crown pillar is currently dewatered, fractures are exposed to oxidizing conditions and the drip and seep survey data show that water is overwhelmingly neutral to alkaline.	2-17	2-17: It is also very important to realize that the current mine inflow reflects mine workings that have only been open a few years and does not represent long term post-closure conditions, as identified by testing in the June 1995 "2750 Level" Report. The 1995 testing clearly established that long term conditions at the "Old Timer's Adit" reflect static test results identifying PAG rocks, while short term conditions at the same rock types in new adits typically do not show pH declines. Where the prediction is neutralized ARD after a long lag time as identified in the report (see Responses 1-11, 1-13, 1-17, 1-19, 1-24), it is contradictory logic to imply that lack of immediate pH decline in seep water quality in new workings is somehow an indication that neutralized or unneutralized ARD will not develop in the future.
Page 34/35, section 6.4.1, P5 - This text says that acid generation over time is predicted to resemble the conditions observed in the Old Timers adit. This is not correct. The results of wallrock rinsing studies in the Old Timers adit were used to conservatively characterize groundwater flowing laterally into the mine through the mine walls. A massive sulfide deposit adjacent to the fault zone and lying beneath an open borehole was rinsed in the Old Timers adit and yielded low pH values. This condition is not predicted to be prevalent in the mine following mining.	2-18	2-18: That is not a correct description of post-closure conditions (see Responses 1-11. 1-17, 1-27), which more specifically are expected to resemble the wet areas in the Old Timer's Adit. High sulfide values are expected to be present in wall rock throughout the mine. This was evaluated in detail in 1994 by BLM and EBM by examining the distribution of sulfide contents in final stope walls based on extensive close spaced drilling and analysis of the cores (see Response 1-11). The widespread distribution of sulfides throughout the mine was one of the key reasons for limiting mine development in the 11/30/94 ROD. As the mine refills, inflow seeps and high moisture conditions are expected to contact sulfide exposures throughout the mine.
Page 35, section 6.4.1, P3 - It is not clear nor is there evidence offered why blending backfill at a stope-wide scale to meet ROD criteria for ANP/AGP and NNP is less conservative than when applied to a single rock type.	2-19	2-19: See Responses 1-5, 1-19, 1-29, 2-7, 2-22). EBM seeks to apply averaging as though this was a homogenous material with uniform composition and distribution of materials. In fact, this is a heterogenous mixture of materials with highly variable sulfide composition and distribution. Mehling, et al., 1997, notes, "The ability of the blend to approach ideal conditions depends on the intimacy of contact between the acid generating rock types and also on the degree of heterogeneity", "Blending not only requires a high degree of mixing of different rock types, it also requires that water does not flow preferentially through the net acid generating material." and "Operational Commitment and Monitoring; Generally, blending will require a high degree of operational control...A blending operation would require at least the following components...Confirmation that the blending criteria is being met or exceeded." Particle sizes, mineralogy, pyrite oxidation rates, rate of carbonate dissolution, rate of oxygen diffusion, rate of water infiltration, pH, temperature, vertical or lateral variability in the strata, modes of pyrite oxidation (chemical or bacterial), presence of alkaline material can effect predictions. Price, et al., 1997, identify variability of materials and use of average composition instead of by specific rock type.
Page 35, section 6.4.1, P4 - This text notes that between 40 and 50 % of the waste rock is PAG. Again, this is an overstatement based on a lithologic definition of PAG and not static test data.	2-20	
Page 36, section 6.4.1, PI - This text suggests that acid generating reactions will persist and continue until the pyrite has been oxidized in fracture surfaces. Geochemical test data (SEM analysis, humidity cells) indicate that not all the pyrite would oxidize and that there is ample neutralization potential to neutralize any acidity produced. An October 9, 1997 technical memorandum summarized the results of modeling and showed that even using very conservative mine inflow chemistry (i.e. low pH), up to 2 million tons of PAG backfill could be placed in the mine and the resulting overall backfill would meet the requirements of the ROD for AN/AGP and provide ample neutralization of acid even if only 35 % of the ANP were available. This modeling was performed after consultation with BLM officials to provide an "envelope" of the amount of PAG waste which could be placed in backfill without compromising the ability of the backfill to neutralize	2-21	

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		2-20: The amounts are as accurate as EBM has been able to measure and estimate. Schafer and Assoc. incorrectly applies backfill testing results. Those tests only identify adequacy of blending to add sufficient neutralizing material to meet ROD criteria. The composite tests of PAG and NAG rocks do not characterize the potential of the component rock types to generate acidity within the mixture. 2-21: Humidity cell test data show that pyrite will continue to oxidize over time. In a memo on July 17, 1997, EPA responded to the Schafer & Assoc. contention that a large portion of the pyrite is non-reactive, stating "From the scanning electron microscopy by David Mogk (Appendix C8, 1750 report), the pyrite would appear to be rather reactive. Both sulfate and hydroxide reaction products were commonly noted in samples of wall rock. A better characterization might be that although pyrite is reactive, neutralization reactions are also occurring. If pyrite were in fact not reactive, then the abundant iron hydroxide reaction products used in the geochemical model to adsorb trace metals would not be very abundant." As noted by testing for the 2750 report, as little as 15% of the ANP of the overall backfill might be available if carbonate coating occurs, although data from other sites indicates that usually at least 20% of the ANP might be available. See Responses 1-28, 1-29. Evangelou, 1995, notes "At least in theory, pyrite oxidation could be controlled by removal of FeIII from solution. This could be accomplished by thoroughly mixing pulverized limestone with the pyrite such that direct contact between pyrite and limestone is made. However, even under such ideal conditions, oxidation of pyrite would not stop since dissolved oxygen would carry on the reaction (Moses et al., 1987, Moses and Herman, 1991). ... in the case studies by Nicholson et al. (1988, 1990), direct contact between limestone and the surface of pyrite was not an issue since the researchers employed 0.005 mol L^{-1} $NaHCO_3$ solution. Their data suggested that even under such ideal conditions pyrite oxidation by O_2 was significant."

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acidity. This approach was taken to preclude the necessity for detailed modeling revisions if the amount of PAG produced varied from the predicted amount.		
Page 36, section 6.4.1, P2 - This text notes that humid conditions are more conducive to acid generation. This term is used throughout this and other sections of the document. It would be more accurate to say these conditions are conducive to pyrite oxidation. It is a subtle but important difference; the excess ANP in the mine render the production of acid on a moderate or large scale very unlikely. Any acid produced would be neutralized in proximity to the location of acid production, predominantly at the microscopic scale.	2-22	2-22: See EA document #52 and Responses 2-1: Pyrite oxidation involves production of acidity. As Evangelou, 1995 (Pyrite Oxidation and Its Control), notes "Pyrite oxidation takes place when the mineral is exposed to air and water. The process is complex because it involves chemical, biological, and electrochemical reasctions, and varies with environmental conditions. Factors, such as pH, pO_2, specific surface and morphology of pyrite, presence or absence of bacteria and/or clay minerals, as well as hydrological factors, determine the rate of oxidation. There is, therefore, no single rate law available to describe the overall kinetics of pyrite oxidation for all cases. It has been reported that pyrite in mining waste or coal overburden is initially oxidized by the atmospheric O_2, producing H^+, SO_4^{2-}, and Fe(II). The Fe(II) can be further oxidized by O_2, into Fe(III), which in turn hydrolyzes and precipitates as amorphous iron hydroxide releasing additional amounts of acid (Nordstrom, 1982a and references therein). During this initial stage, pyrite oxidation is a relatively slow process (Ivanov, 1962). However, as acid production continues and the pH in the vicinity of the pyrite surfaces drops below 3.5, formation of ferric hydroxide is hindered and activity of Fe^{III} in solution increases. Under these conditions, oxidation of pyrite by Fe^{III} becomes the main mechanism for acid production in mining waste (Singer and Stumm, 1970; Moses et al., 1987 and references therein)." Evangelou, 1995, also notes, "carbonate rock effectiveness in controlling pyrite oxidation is at times controversial. Earth carbonates are known to have a reducing effect on acid production from pyrite oxidation by limiting Fe(III) in solution, but carbonates are not known to be able to limit pyrite oxidation in a chemical way." and "In fact, Stiller et al. (1985) noticed that in the presence of limestone pyrite oxidation appeared to accelerate. It may be possible that at the microscopic scale pyrite oxidation in the presence of alkaline material is controlled by the turnover rate of Fe^{III} near the surface of pyrite and not by the solubility of $Fe(OH)_3$ in pure solutions." "a low pH could exist near pyrite surfaces even when alkaline earth materials are present. The relatively high pH near alkaline material surfaces promostes inorganic oxidation of Fe^{II} to Fe^{III} and consequently the large quantity of Fe^{III} available near pyrite surfaces due to diffusion, promotes S_2^{2-} oxidation."
Page 36, section 6.4.1, P4 - The model results in the 1998 impact evaluation used conservative inflow sources. The "best" inflow water quality was neither defined nor used. Rather, the scenario where background upgradient water would flow into and through the mine over time was addressed qualitatively.	2-23	2-23: Background upgradient water would be considered the "best" inflow water quality available.
Page 37, section 6.4.1, P1 - The long-term water quality predictions were determined using the chemical equilibrium model PHREEQC and represent equilibrium conditions. The model is driven by calcite equilibrium and the relative percentage that each inflow chemistry comprises of the total inflow. The "rate" of filling, per se, does not affect the model. However, a more rapid filling time would obviously reduce the amount of time sulfides are exposed to oxidizing conditions.	2-24	2-24: See Responses 3-28 and 4-3: While a more rapid filling will reduce exposure time, all of the backfill and mine walls will have been exposed to oxidation for many years prior to mine closure, and the crown pillar may be exposed perpetually if the mine does not refill above the level of the valley.
Page 37, section 6.4.1. P2 - Again, this text implies that acid generation in the crown pillar will occur and persist. Although some oxidation of pyrite will occur, geochemical and drip/seep survey data do not support this claim. Also, the statement that filling of the mine with water to higher elevations will result in better water quality is a based on the presumption that the crown pillar will produce acid and ignores the fact that the mine water chemistry is strongly controlled by the presence of a copious amount of limestone (calcite).	2-25	2-25: See Responses 1-13, 1-23, 1-24, 1-60: The consultants used the rationale of complete refilling as a basis for predicting better water quality. The June 1995 "2750 Level" report stated "This refilling will resaturate the mine voids and the surrounding rockmass...This will deny oxygen to the remaining sulfide minerals, extinguishing any acid-generating reactions which may have initiated...Sulfide oxidation will at that time return to the natural (pre-mining) rates.. Accordingly, ... only natural rates of sulfide oxidation are expected after the mine refills with water." The July 1995 "Impact Evaluation" states, "the threat of contamination of groundwater and surface water is limited to localized acid rock drainage (ARD) within the mine." Current seep water quality data is not an indicator of future water quality (see Response 1-70).
Page 37, section 6.4.1, P4 - This paragraph uses model water quality results to imply that controls of mine water discharge will be necessary to prevent undue or unnecessary degradation of groundwater outside the project area. However, the text (earlier sections) also notes that monitoring data will be used to determine if controls and mitigative measures will be required to prevent groundwater impacts. Therefore, the text in this paragraph of the EA is speculative.	2-26	2-26: Controls of mine water discharge are needed to prevent unnecessary or undue groundwater impacts and there area a variety of mitigation measures under the RODs. Some measures, such as water treatment, would not come into play unless monitoring indicates that other measures have proven inadequate.
Page 38. section 6.4.3, P. - It would be better to rephrase the final sentence of this paragraph to underscore the fact that even with the addition of 1 to 2 million tons of PAG and the reduction of ANP due to coating of limestone, neutralization potential was still ample enough to neutralize acidity in mine water.	2-27	

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		2-27: This was considered in EA Section 6.4.3, Alternative No. 2. See Responses 2-1, 2-19, 2-22, 2-25. The model evaluated the maximum amount of PAG that could be added before acidity might consume all available neutralization potential under the conditions defined for the model. The model is a tool to assist in predicting future impacts but the results of the models are not entirely dissuasive, given all the factors involved.

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AdrianBrown August 13, 1998 United States Department of Interior Bureau of Land Management Spokane District Office 1103 N. Fancher Spokane, Washington 99212-1275 Attention: Cliff Ligons, Border Resource Area Manager Subject: Lamefoot Incremental Expansion Environmental Assessment Comments 1371A INTRODUCTION The Bureau of Land Management (BLM) has issued Environmental Assessment No. EA-130-08-14 for the Lamefoot Mine, Plan of Operation Modification, WMP-130-89-019B, Interim 3070/North Lamefoot Proposed Modification, dated July 24, 1998, for comment. The following comments are submitted by Adrian Brown Consultants, Inc., on behalf of Echo Bay Minerals Company, the proponent for the proposed modifications. GENERAL COMMENTS The Environmental Assessment of the proposed incremental change to the Lamefoot Project (the EA) is considered to reasonably present the reasons why there will be no significant impact to the groundwater system due to the proposed action, and is supportive of the Finding of No Significant Impact which is proposed.		
There are nonetheless within the EA a number of matters which appear to be in error, the correction of which would not change the overall finding (they in general cause the impact presented in the EA to be overestimated rather than underestimated). This document identifies those matters.	3-1	3-1: BLM does not agree that these items are "in error". See Responses 1-18, 1-41, 1-58 and EA page 4.
SPECIFIC COMMENTS Page 4, right column. paragraph 2: Some of the analyses performed for the 1998 groundwater impact evaluation were designed to provide a reasonable upper bound to the actual impact that could be generated by this project, in particular in respect of the possible impact on the result of subsidence which might occur in the crown pillar, and flow which might occur along higher permeable materials which have been occasionally encountered in the groundwater system. This approach was taken voluntarily by the EBM team in order to simplify the evaluative process, by removing the need to quantify in detail some parameters which are very difficult to evaluate with precision. The BLM indicated that it accepted the approach, but not with the description used, which was "worst case". This term was dropped by the EBM team at the BLM's request. With respect to the final groundwater impact evaluations, two analyses were performed to resolve this issue:	3-2	3-2: See Responses 1-47, 1-48. EBM's team used certain parameters for permeability in lieu of calculating the permeability indicated by the rock mass displacement modeling results. However, on a practical level, the parameters used had essentially the same effect as might be predicted for the actual rock mass displacement within the crown pillar. The approach was accepted by BLM on the condition that the report identify that the values used were essentially equivalent to the values that would be predicted for the crown pillar. See Response 1-71. As stated by Adrian Brown Consultants in a memo dated April 23, 1998, "It is agreed that the infinite permeability backfill and the infinite permeability crown pillar assumptions are likely to be close to the reality which might be expected; however, they are still "worst case" assumptions for the analysis, and have been retained." (emphasis added). BLM did not accept EBM's initial report because. 1) BLM had specifically indicted that a worst case analysis was not desired, and 2) the document did not present a worst case, although that term was used throughout the document. As such, the term "worst case" involved mislabeling that misrepresented the contents of that report and gave an erroneous impression of the report contents and conclusions, rendering the document unacceptable. The "expected case" does not "considerably over-estimate" the impacts, it simply omits the effects of possible effects of grouting noted in the June 1995 "2750 Level" Report, Appendix A. See Responses 1-32, 1-41, 3-18, 3-23. Note that EBM has asserted that the 1994 grouting records indicate, "The shifter's reports may either state the drill hole or seep location that was grouted or may state a mine location that was grouted, indicating that all drill holes and seep locations that exist at that location were grouted (for instance one drift location that is indicated as having been grouted may include grouting many drill holes or seeps at that location)." EBM has not provided any evidence documenting that grouting in 1994 included anything other than boreholes, and the shifter's reports provided by EBM do not mention grouting of seeps. Nevertheless, even if only boreholes were grouted in 1994, those boreholes would have intercepted fractures and the grouting process would have had some influence on the immediately adjacent rock mass. Given the number of holes and the limited size of the area involved in 1994, grouting may have influenced the local permeability of fractures adjacent to mine workings.
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an "expected" case (which still considerably over-estimates the likely impact to the groundwater system), and a "conservative" case, which approaches the maximal condition (for example by using the highest permeability test results for faulted material, the largest possible extent for these faults, and using an infinitely permeable crown pillar). As neither analysis indicates significant impacts, it is considered that the incremental mining action proposed is very protective of the environment. It is suggested that the discussion in this paragraph of the EA be modified to reflect the positive aspects of this matter, rather than to suggest that there is a problem with the approach.	3-2	
Page 6, left column, paragraph 3: The report characterizes that the 2750 report in 1995 found "major environmental impacts" associated with the full mine development. This is incorrect; no such impacts were identified, and a FONSI was issued based on that finding.	3-3	3-3: See Response 3-5. The 1995 conclusion was a mitigated FONSI, subject to mitigation in the 11/30/94 and 9/20/95 RODs.
Page 7, right column, paragraph 2: The report suggests that there have been measured groundwater impacts to date; there have been none, save drawdown within the mine itself, which has not had an environmental effect. The correct statement is that the model was "calibrated against actual groundwater head and flow data collected at and near the minesite".	3-4	3-4: Drawdown of groundwater surrounding the mine is an environmental impact that is indicated by the "groundwater head and flow data collected at and near the mine site."
Page 8, left column, paragraph 2: The subsidence model in 1998 was not used to develop parameters for the hydrology model. Rather, to resolve fears raised by an extreme analysis of possible subsidence in the crown pillar performed for BLM by an external contractor, EBM's consultant chose to adopt an infinitely permeable crown pillar in the analyses of the hydrology of the mine. This choice meant that any protections which the real crown pillar might provide in limiting inflow to the mine of surface water were ignored, which is a conservative approach with respect to impact due to flow through the mine void.	3-5	3-5: The 1995 modeling yielded results for sulfate and manganese similar to those in 1997 & 1998 modeling. The July 1995 "Impact Evaluation" stated on page 47, "There will in addition be a considerable mass of metals which remain within the mine void, as a result of any neutralizing of any ARD which might have formed during mining and refill (although little is expected). The low permeability of the wall rock will prevent this material from being mobilized out of the mine, so that only the dissolved metals are capable of leaving the mining void." ... "Non-attenuated species undergo significant dilution in the flow system. First, within the mine it is expected that there will be mixing of non-ARD water with a small amount of neutralized ARD, reducing concentrations at source substantially below those shown in Table 6-1." (emphasis added.) Table 6-1 lists 1441-2560 mg/l sulfate and 1.1-3.0 mg/l manganese. Section 6.5 states, "An evaluation of the likely range of water qualities which will exist in the mine after refilling has been performed, and is presented in Appendix C." Table C-3 lists 1489-2238 mg/l sulfate (PHREEQE) and 1441-2238 mg/l sulfate (MINTEQA2); 1.099-1.813 mg/l manganeses (PHREEQE) and 1.102-2.549 mg/l (MINTEQA2).
Page 12, left column, paragraph 2: A drawdown of 300 feet in 1995 is discussed in this paragraph, with the implication that the drawdown has risen to 600 feet in 1997. These "drawdowns" are measured immediately adjacent to the mined void, which at the 1995 location was approximately 300 feet below the original ground surface and the original water table, and at the 1997 location was approximately 600 feet below the original ground surface and water table. Detailed testing indicates that there has been no evidence any spread of drawdown away from the mine, despite the presence of the dewatered mine void for approaching five years. This fact is indicative of the conservatism of even the "expected" case analysis of the groundwater system, which (conservatively) predicts more some spread of drawdown when essentially none has occurred.	3-6	3-6: The time period stated is not a "fact"; all drawdown did not occur over five years. Excavation of the 2225N exploration drift into the North Lamefoot area was completed in September 1997, and most of the drawdown around that drift occurred rapidly from September through the end of November in association with ongoing drilling of exploration boreholes from the drift.
Page 13, right column, Table 2: This Table claims to present values of "relative capacity for rate of water movement". However, what is actually presented in the table is the hydraulic conductivity of the various materials. The table is particularly misleading. The amount of flow through a material ("relative capacity for rate of water movement") is dependent on the product of the hydraulic conductivity of the material (presented in the table), the area of the material involved in the flow, and the hydraulic gradient associated with that flow. In the case of the table, while the hydraulic conductivity of some local fractures are indeed high, the area of them is very small when compared to the area of the "normal" country rock, and the gradient of flow through the major fractures is likely also to be low (due to their lower resistance to flow). Thus, the relative capacity for rate of water movement between the overall rock mass and the few local fractures is likely to favor the overall rock mass, not the few high conductivity local fractures, as the table implies. Secondly, the unit of hydraulic conductivity is the unit of velocity (in this case, feet per year). The table appears to suggest, and might suggest to a lay person, that the actual velocity of water in the this	3-7	3-7: The units presented in the table are those used in the 1998 "Impact Evaluation" report (p. 7) and June 1998 supplement by Adrian Brown Consultants (p. 7). The footnote in EA Table 2 states, "Gives comparison for different capacities identified by each study. Actual rates of flow also depend on other factors. Actual rates of flow, especially for fractures, would likely be substantially less than indicated over a long distance." Depending on the location of the fracture, the degree of connections to the mine workings and the surface, the distance involved, and other factors (e.g., "hydraulic conductivity of the material..., the area of the material involved in the flow, and the hydraulic gradient associated with that flow"), the conductivity of the rock fractures may predominate over that of the overall rock mass. As noted in EA document # 57, "Drainage into the mine will then be directed towards the mine pools, allowing a build-up of hydrostatic head and creating potential seepage areas when these pools intersect the joint system."

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groundwater system could be up to 1, 100 ft/yr. This is not true. Again, the velocity of flow in the rockmass is dependent on other parameters as well, including the porosity and the hydraulic gradient. Actual flow rates in the overall rock mass are substantially lower than these values, in the order of a foot per year or less. This section, and the entire discussion on faults and their hydrogeologic effects, is based on incorrect application of hydrology principles.	3-7	3-7: Actual flow rates could be higher than the comment indicates, e.g. movement for a distance of 60-100 feet to the surface through a crown pillar fracture could take place more rapidly if the fracture had hydraulic conductivity on the order of those noted in the 1995 and 1998 "Impact Evaluation" reports. See EA document #37.
Page 14, left column, paragraph 2: The discussion might suggest to a lay person that, there are large flows of water in the area tested. There are not. The text could be read to suggest that the first well tested was flowing for two months at 50 gpm. This is not true. The situation was that the well was shut in, and when opened flowed briefly at up to 50 gpm, before reducing to a few gallons per minute. The same is true with respect to the "239 gpm of flow. These tests drained localized zones of permeable rock, after which flow essentially ceased. The dramatic reduction of flow in the tests clearly indicates that there is no sustained permeable system in the bedrock in the vicinity of the mine; indeed the overall rockmass is of very low overall hydraulic conductivity, typically less than that of clay (10^{-6}, cm/sec). This condition is very protective of the environment, as little water can flow into, through, or out of, the area influenced by the mine excavation.	3-8	3-8: See Responses 1-35. 1-36. Shift reports document that water flows were present from a series of open holes almost continuously throughout the month prior to the test.
Page 13, left column, paragraph 2: While it is true that the Wolf Camp fracture zone dips westward, and that Curlew Lake is to the west, the nexus of the statements may lead a lay reader to conclude that there is a connection by this means. There is no evidence that the fracture zone connects the lake with the mine area, and the steepness of the feature ensures that it cannot connect the lake with the mine area[1].	3-9	3-9: See Responses 1-39, 1-55. BLM agrees that Wolf Camp fracture zone dips westward at an angle that would project beneath Curlew Lake. No fracture or joint mapping or studies have been presented to BLM. Figure 2-2 in the June 1995 "2750 Level" report identifies general major fracture patterns in the vicinity between the mine and Curlew Lake. The extent of connections (existence or absence of connections) along or between those fractures has not been established by testing. Testing has identified that there is continuity westward down dip along the fracture zone from the mine as far west as monitor well LF-14. The Wolf Camp fault zone intersects with westward trending faults that apparently extend to Curlew Lake. Regardless of the dip angle or direction, the southern end of the Wolf Camp fault is mapped as curving westward and striking directly toward Curlew Lake.
Page 14, left column. third paragraph: The wetlands have not been impacted. While more monitoring is proposed in the EA, the areas referenced have been monitored, so the term "but" would appear to be inappropriate, suggesting as it does that unmonitored impact may have occurred.	3-10	3-10: The areas have not been adequately monitored, so the extent of impacts cannot readily be determined. Monitoring reports indicate wetlands were visited from Sept. to Dec., 1997, but records do not accurately measure the conditions so conclusions of no impacts in the 1998 "Impact Evaluation" are questionable. The wetland station no. 3 at 2529.7 ft. elev. summary is listed as "dry" or "below gauge" continuously for 16 months from Sept. 1996 through Dec. 1997. The wetland station no. 4 at 2464.7 ft. elev. is listed as "vegetation blocking gauge" for 11 months and "frozen" for five months from Sept. 1996 through Dec. 1997 without recording actual water surface elevations. This problem of inadequate monitoring persists to the present time despite repeated BLM requests for EBM to correct these deficiencies, and despite EBM's continued assurances that the corrections will be made. Physically visiting the wetlands without taking the required measurements of water elevations does not constitute monitoring as specified in the Hydrologic Monitoring Plan of the Plan of Operations, and failure to obtain this information may be considered noncompliance.
Page 14, right column, fifth paragraph. This paragraph appears to consider that 100% of all drill holes require plugging before the mine can be considered impact-free. This is unreasonable. Clearly a single open drill hole has the ability to conduct all the expected flow into the nine after closure (13 gpm, ABC, 1998). However, the analysis of the mine outflow essentially assumes that all this flow passes through the faulted material directly into the alluvial material in Wolf Camp Creek, yet finds that there is no adverse effect. Thus, even if the scenario occurs, no harm is expected. This is true for multiple unplugged holes; grouting holes is actually unnecessary, rather than the reverse which is advanced in this portion of the EA (and repeated often later in the EA).	3-11	3-11: As the comment notes, "the analysis essentially assumes that all this flow passes through the faulted material" which results in attenuation. Flow through an ungrouted borehole is a much faster, more direct outlet for discharge with relatively little surface area contact and essentially no attenuation. Water quality impacts of unattentuated flow through an ungrouted borehole were not evaluated in the 1997/98 models. See Responses 1-18, 1-45, 1-60, 2-10. The 1998 "Impact Evaluation" report noted that cadmium, sulfate and manganese were not fully attenuated and relied on an unspecified amount of dilution to address those potential impacts.
Page 15, left column, paragraph 1: The discussion of the groundwater inflow makes it sound like both measured and estimated flows have changed greatly during the project. Neither is true. Recent flows to the mine have been a little higher, probably due to somewhat wetter years. Recent inflow estimates have been higher due to a greater level of conservatism in the analyses. Nothing appears to have changed in real life. The flows have been, and remain, insignificant when compared to other underground mines, and to the impact that could occur as a result of them in this mine.	3-12	

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[1] To be conservative, however, the modeling performed for the EA extends the fault system so that its surface trace connects with the lake. This is not, however, due to the dip of the feature, but to ensure that this possibility was, considered.

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Comment	Number	Agency Response
		3-12: Measured flows have changed during the project and there has been a change in "real life". That is a matter of measurement, not "a greater level of conservatism". Measured average flow in 1995 was 7 gpm (6 gpm measured seep inflow plus 1 gpm lost to evaporation), with maximum recorded inflows of 20 gpm. Measured average flow for 1996/97 was 16 gpm (1998 "Impact Evaluation" report) with maximum recorded inflows of 59 gpm. No data comparison was presented in the consultants technical studies indicating recent "wetter years" or showing any such correlation with mine inflow. The evaporative losses estimated by BLM in the EA are probably the minimum, given the magnitude in increase in surface area of mine workings (see Response 1-75). Also, the issue is not a comparison with other mines. The issue here is the analysis of potential impacts related to one mine (Lamefoot Mine) adjacent to Curlew Lake, a State Park, resort facilities and domestic water supplies.

Comment	Number	Agency Response
Page 17, right column, last paragraph: The subsidence study done for the BLM does not show that crown pillar void space will occur, nor does it make any attempt to quantify the resulting permeability, except to say it will rise. The study is so extreme that it is questioned how applicable it is to the real-world situation which exists today at Lamefoot, or will exist as a result of the incremental expansion. In particular, the study assumes that an entirely unsupported void is mined, leaving the mine covered by a crown pillar of as little as 50 feet thickness, with a length of 2,000 feet and a width of up to 500 feet (approximately the same size as the unsupported roof of the Kingdome). If this were to occur, it is correct that such a "roof' would deform, and become more permeable, as the model predicts. The mine plan is different. The maximum mine void opening is about 200 feet long by 50 feet wide, with crown pillar more than 50 feet thick. This rigid beam will not subside significantly in theory, nor has it subsided unmeasured practice at this mine. The BLM appears to agree with this assessment; on page 19, left column, paragraph 2 states that "backfill provides support to prevent subsidence of the ground surface after mining". And the bottom line is that there has been no subsidence, despite the BLM previously noting that this would occur instantaneously on mining. This subsidence issue is raised frequently through the EA, and is wrong. See also page 34, which asserts that subsidence has occurred, yet also that none has been measured, and page 38, where the BLM states that it will take decades or longer for subsidence to occur.	3-13	3-13: BLM does not agree with the generic assessment of "support" by Adrian Brown Consultants and has responded to this comment; loose backfill just eliminates the void space and would constrain the magnitude of a major failure after mine closure. The CANMET model shows a net increase of 0.4 inch in void space short term, and long term increase in void space was estimated to be up to 0.8 inch in void space. In a letter of January 23, 1998, CANMET previously responded to this comment from Adrian Brown Consultants, stating "It has been recognized that displacements within a rock mass are not represented by discontinuum modeling or beam/plate theory for jointed rock masses as used by J. Abel. ... Mr. Brown should understand that 2D models do include the effects of stope walls and backs, in a continuous fashion. Although rib pillars add a third dimension element when their spacing is long, these effects have been shown to be minimal with respect to displacements. No pillars are planned at Lamefoot between stope extremities. ... On the subject of cemented backfill (which is used in primary stopes 7m wide, uncemented fill in wider secondary stopes 7 to 14 m wide) and stope wall displacement, Mr. Abel and Mr. Brown point out correctly that there will be an effect in confining the rock mass. However one must take into consideration the time dependent behaviour of underground opening periphery and the timing of the installation of wall support. ...There will be an instantaneous elastic displacement over the initial few days after stope creation ... with a longer term delayed elastic response. The instantaneous response represents about 60% to 80% of the long term displacement. In order not to miss this rapid stope deformation, fill must be emplaced rapidly after the new opening is blasted. I was informed during my site visit by mine staff that fill emplacement begins no earlier than 2 to 3 days after opening creation, hence our anticipation that most wall movement will have taken place as stated on page 8 of our July 1997 report. Mr. Brown should also understand that uncemented fill has very little effect on elastic rock mass deformation due to its cohesionless, purely frictional resistance. Furthermore, rock bolting is only applied to the crown of development drifts, the stope-walls remain unsupported in this regard. In conclusion, I believe that Mr. Abel's approach varied from ours in that we conducted our analysis based on rock mass and in situ conditions whereas he concuted his essentially with behaviour which would not represent a jointed rock mass response." The CANMET analysis determined that the current monitoring system is incapable of measuring displacement within the crown pillar, and identified a monitoring system that could be installed to track this movement as it is occurring now. Although it would be possible to collect the data mentioned in the comment, EBM strenously objected to installing this network and has refused to do so voluntarily.
Page 21, right column, last paragraph: There is no evidence that the mine has denatured any material possibly excepting small portions of the crown pillar. As noted in a comment above, there is also no evidence of any progressive depressurization or dewatering, beyond the material actually removed by mining.	3-14	3-14: As the comment notes, there is evidence that the area above and immediately surrounding the mine has dewatered.
Page 23, left column, second paragraph: The characterization of the results of the 1998 modeling are inaccurate. As a general matter, the analysis was deliberately conservative or highly conservative. In particular, the assumption of an infinitely permeable crown pillar ensured that flow to and from the mine would go directly to Wolf Camp Creek, the shortest route through this conduit. Thus, it is not true that the model "predicted that outflow would be via the Wolf Camp and Gravel Pit faults", it essentially required that this be true.	3-15	
Page 23, left column, paragraph 4: It is not possible that more water flows into the mine from Wolf Camp Creek, as is implied by the condition stated. All of the flow in the alluvium and the Creek is already captured by the mine in the modeling (though not in real life), due to the conservative nature of the model.	3-16	
Page 23, left column, paragraph 4: The spring flow does not appear to have changed materially during the mining to date, which extends essentially beneath the subject area. Accordingly, the spring does not appear to have been affected.	3-17	
Page 24, left column, first paragraph: As noted, there are a number of flow paths for water to move in the mine system. Plugging one of them (the boreholes) will not materially change the inflow to, the flow through or the outflow from, the mine, either before, during, or after mining, Grouting is unnecessary, because the flow cannot be prevented by this or any other means. This statement notwithstanding, it will if desired be possible to prevent all the flow merging at one location if it does actually occur, but plugging the conduit along which it is passing, whatever it is. Thus, mitigation on identification of an undesired outcome is readily available, so in this case mitigation before the fact (grouting) is unnecessary and highly inefficient as a means of environmental protection.	3-18	

Comment	Number	Agency Response
		3-15: See Response 1-1: A memo by Adrian Brown Consultants dated April 23, 1998, titled "Response to Comments By BLM On Lamefoot Incremental Expansion" stated, "It is agreed that the infinite permeability backfill and infinite permeability crown pillar assumptions are likely to be close to the reality which might be expected"; "it is correct that the backfill will be of high permeability." and, "The model does not 'route water from the mine into the Wolf Camp Creek'. The model happens to result in almost all flow moving into the creek, rather than through the low permeability rocks between the mine and Curlew Lake. It is a three dimensional representation of the flow system." (emphasis added). 3-16: The model indicates that subsurface dewatering of groundwater by the mine would not likely extend as far as the southern wetlands. However, if the model indicates that all of the water from the spring is captured by the mine, then there would be an impact on the southern springs due to the loss of surface flow. This may be a limitation in the ability of the model to fully reflect all conditions accurately. 3-17: BLM agrees that is the current situation. 3-18: See Comments/Responses 4-2, 4-4. Ungrouted flow would create a direct impact from unattenuated water discharged from the mine. As described on EA page 24, it will not readily be possible to detect or underground boreholes or fractures from the surface following mine closure.

Comment	Number	Agency Response
p.25: Table 4 appears to suggest that the flows indicated would have occurred except for grouting. This is an incorrect interpretation of the analyses from which the information in the table was taken. The analyses which are cited in the table for the "Conservative" and "Expected" cases have exactly the same consideration of the effects of grouting (none). The difference between the flows derives entirely from differences in assumptions about infiltration and fault zone permeability). The difference has nothing to do with grouting. Likewise, the implication that the difference between the observed and computed inflow during mining is due to grouting is unsupportable, it is more likely that it is a reflection of the remaining conservatism of the modeled analysis. Also, the flow units for the data in the table (apparently gpm) should be noted somewhere on the table. Page 25, left column. fourth paragraph: The 1994 FEISS has been shown to be wrong in its tenfold increase inflow estimate.	3-19	3-19: BLM agrees that the 1997/98 model did not address grouting, but grouting is a requirement of the 11/30/94 ROD to minimize potential impacts outside the mine and project area (see Response 1-32). Therefore, Table 4 shows the modeled flows for the "Conservative" and "Expected" cases and the reduced flows for each case where grouting is used (see EA Table 4 footnotes) based on the FEISS analysis. The rationale presented in this comment is inconsistent with previous explanations; see Responses 1-41, 3-2, 3-30 regarding the difference between observed and computed inflow. The FEISS has not been "shown to be wrong". The flow units in Table 4 are gallons per minute.
Page 28, left column, second paragraph: The concept that plugging conduits by grouting will make flow more diffuse, and therefore more beneficial geochemically, is questioned. It is at least as likely that plugging some conduits (it is impossible to plug them all) will force all the flow into fewer conduits, thus increasing the velocity of flow in the remaining conduits. Thus, in this matter also, grouting may be more harmful than beneficial.	3-20	3-20: While it may be possible that increased head may "force flow into fewer conduits", those other conduits will also involve smaller fractures and lower hydraulic conductivity. No evidence has been presented to demonstrate how this would be "more harmful than beneficial" as stated in the comment.
Page 28, right column, Table T- Table 7 is misleading. It suggests that for the most part the protection due to attenuation fails, whereas the reverse is true. That the table is misleading can be illustrated by reference to the fact that cadmium meets the relevant standards within the mine, so how far it goes before attenuating further is irrelevant. Further, no attenuation is claimed in the evaluations performed for sulfate, nor is any needed, Finally, the species which is important to attenuate (principally zinc) is important to protect aquatic communities at the lake. This species is attenuated well by the system.	3-21	3-21: The statements about cadmium are not correct. While human drinking water standards are currently 0.01 mg/l, studies have documented impacts to fisheries at lethal concentrations of LC 50, 0.0006 mg/l to 0.007 mg/l and sublethal effects as low as 0.00047 mg/l to 0.006 mg/l for long exposure periods (see US Fish & Wildlife Service, 1985, Biological Report 85(1.2) - Cadmium Hazards to Fish, Wildlife, and Invertebrates, A Synoptic Review). The initial pore volume of the model showed cadmium concentrations of 0.0004 mg/l in the mine which rise to 0.006 mg/l by the tenth pore volume. The 1998 "Impact Evaluation" noted that cadmium is not fully attenuated during transport. Therefore dilution is an important consideration.
Page 28a: Table 8 is misleading, and adds nothing of substance to the EA. It states (for example) that if 6 gpm to 26 gpm of neutralized ARD is taken and discharged to the alluvium, water quality will fail a couple of secondary parameters. While true, this does not appear to be germane to this EA, as the contemplated conditions will not in future occur, and even if they did could be readily mitigated (by plugging the discharge point),	3-22	3-22: BLM appreciates your acknowledgment that the EA analysis is correct, but notes that concentrations for sulfate and manganese cannot be lightly dismissed as just failing "a couple of secondary parameters." See EA Sections 6.2.1.5 and 6.7 about the potential magnitude of impacts involved with failing those secondary drinking water standards and Response 1-18. Such impacts are certainly germane to this EA. NEPA requires analysis of impacts to the human environment and people are part of the environment, along with wildlife, fish, plants, etc. NEPA CEQ regulations under 40 CFR 1508.14 requires that "The human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." Plugging (or even locating) the discharge point from the surface after mine closure may not be so readily feasible (see EA page 24).
Page 30. left column, last paragraph: To suggest that any impact on wells around the lake, or the lake itself, is possible due to the incremental expansion is not credible, either by common sense, or by the evaluations performed in the studies which support the proponent's application. It is not clear how the EA can make these observations based on the information provided by the proponent, and approved as reasonable by the BLM approved expert review team.	3-23	3-23: As noted in Response 1-17, 1-18, 3-11, 3-18, the 1998 "Impact Evaluation" did not evaluate direct discharge of unattenuated mine water through ungrouted boreholes, and the particular route of discharge that was evaluated involved discharge through a sizeable mass of rock in a fracture zone with commensurate attenuation, instead of through a single or small number of fractures with less attenuation.
Page 30, right column, second paragraph: The statement that the "1995 studies" (presumably including the groundwater flow and quality prediction studies) "assumed that all boreholes and larger fractures would be grouted in accordance with the 11/30/94 ROD is incorrect. Consistent with conservatism, the reverse was assumed, that no grouting was performed. This was accomplished by using hydraulic conductivity values for the rockmass which were significantly higher than the measured values, resulting in a higher predicted inflow to the mine than was observed at the time.	3-24	

Comment	Number	Agency Response
Page 30a: Table 8 is also misleading. It states that if (say) 26 gpm of neutralized ARD is taken and discharged at Wolf Camp Spring, water quality will fail a couple of secondary water quality parameters.	3-25	3-24: It is not at all clear that "Consistent with conservatism, the reverse was assumed, that no grouting was performed. ... resulting in a higher predicted inflow to the mine than was observed at the time." Since grouting was conducted in 1994 and appeared to have substantially reduced the inflow to the mine prior to the 1995 model development, the conclusions drawn by the 1995 modeling analysis were questionable. The conclusions in the 1995 model actually involved a comparison of observed inflow from an grouted mine area with modeling that supposedly predicted inflow from an ungrouted mine area. As a result, it should not be surprising that the model predicted higher inflows for an ungrouted mine than those observed in a partially grouted mine. Modeling in the 1995 "Impact Evaluation" used inflow of 5 gpm through the wall rock and 5 gpm through the crown pillar (total of 10 gpm). Average inflow to the mine at the time was 7 gpm (6 gpm measured seeps and 1 gpm evaporative loss to ventilation). 3-25: See Response 3-22. BLM is required to examine reasonably foreseeable significant adverse impacts that may be possible.

Comment	Number	Agency Response
While true, this again does not appear to be germane to this EA. It is not going to happen, and at no point in the supporting work is it suggested that it is possible. Even if it did happen, it would be easy to prevent. The table adds nothing to the EA, due to the possibility that it may mislead.	3-25	
Page 44, The proposed monitoring is excessive. Monitoring a total of up to 20 wells, many of which have to be installed, monthly, for a large suite of chemical and level parameters, plus a number of wetlands and other surface water features, does not appear consistent with the miniscule threat implied by the mine, or by the incremental expansion. In particular, deep piezometer and water quality analysis are unnecessary, as the only possible conduit which could result in impact is a drill hole or other feature, which will only have an effect after refill, and the effects of which could not be identified by even an extremely close monitor well in this low permeability rock.	3-26	3-26: See Responses 1-63 and EA Sections 6.2.1.5 and 6.7; the potential impacts are not "miniscule" and data collection needs to begin prior to the start of outflow to determine background concentrations at each station and establish a baseline level for measuring impacts after outflow begins.
At the close of these comments are my thoughts on the need for grouting to avoid environmental impact. NEED FOR GROUTING TO AVOID ENVIRONMENTAL IMPACT		
Grouting of all significant inflow locations in the Lamefoot mine is required by the terms of the mining permit to be undertaken for all locations where the inflow exceeds 1 gpm. This grouting may reduce the net flow of ,water to the mine from the surrounding bedrock during mining, but this effect is small, for the following reasons. 1. On grouting, the flow from the formation to the mine reduces 2. As the flow from the formation reduces, the drawdown that that flow was producing in the formation also reduces. 3. As the drawdown in the formation reduces, the head difference between the water in the formation and the head gradient from the formation to the mine (across the grouted rock "shell") increases. 4. The increased gradient increases the flow to the mine again, with the total flow approaching the inflow which would occur without the grouting. After the mine has been closed, and the water level rises in the mine, the same is true; the inflow to the grouted mine after closure is similar to (less than, but not much less than) the inflow to the mine without grouting. Accordingly, the grouting has little effect in reducing the total inflow to the mine during operations, or reducing the total flow through the mine after closure.	3-27	3-27: This possibility was examined (EA document #57). The points presented by this comment (and Comment 3-30) relate to the extent to which the grouting mitigation measures will reduce impacts, not whether they will reduce impacts. Grouting was proposed by EBM in the FEISS to mitigate potential impacts downgradient, the need for the net reduction of inflow/outflow was determined in the FEISS and the 11/30/94 ROD, and grouting is feasible as noted by Adrian Brown Consultants and other EBM consultants (see Responses 1-31, 1-33, 1-41, 4-2, 4-4). --- ---
To the extent that grouting does reduce flow, however, there may be some negative impacts. The current inflow to the mine averages about 16 gpm (including the effects of grouting). At this flow rate it is estimated that it will take in the order of 10-20 years for the mine to fill to close to its final water level. During this time oxygen has access to the unflooded portion of the mine voids. If the inflow were greater, then the mine would refill more quickly, more rapidly eliminating sulfide oxidation in the mine void due to flooding the oxidation locations.	3-28	3-28: The July 1995 "Impact Evaluation" discussed the possibility of artificial refilling to reduce exposure time to oxidation. However, by the time of mine closure, including refilling time, the rocks in the mine would have already been exposed to oxidation a substantial time period (see Responses 4-3). The effects of continued exposure to oxidation during slow refilling were considered in the 9/20/95 EA, and reduced long-term permeability was still considered to be necessary.
Finally, the amount of sulfide oxidized in the mine after closure is primarily a function of the amount of sulfide exposed, and the amount of oxygen which is available to the sulfide (there is sufficient water available		

Comment	Number	Agency Response
to support the oxidation reaction regardless of inflow rate). Thus the rate of release of metals from sulfide oxidation which occurs after closure is not a function of mine inflow. As a result, the rate of flow through the mine will not influence the mass of metals which exits the mine void (the lower the flow, the higher the concentration of metals in the flow). Hence, the rate of water flow through the mine voids after closure does not influence the impact that the mine may have (which has been shown to be insignificant).	3-29	3-29: Oxidation of sulfide minerals is not exclusively dependent of oxygen. Also, the rate of oxidation can be influence by humidity and the presence of water (see EA document #53). The amount of metal release may be influenced by the mode of release, i.e., through a borehole versus through a fracture zone (see Response 3-5).
In summary, the grouting has little impact on reducing total flow to and through the mine, and in any event the impact of discharge from the mine after refill is not influenced by the total flow through the mine. Therefore grouting is not an effective or needed activity with respect to protection of the environment. INFLUENCE OF GROUTING ON MODELING The modeling performed by Adrian Brown Consultants, Inc. does not utilize on include the effects of the reduction of average hydraulic conductivity in the near-mine rocks which presumably is the result of grouting of fissures. This decision was taken in order to produce an over-estimate of flow into, and through the mine void. The analyses performed used the following information regarding hydraulic conductivity: 1. Packer testing of the rock close to the mine, using tests conducted (by Adrian Brown Consultants) in holes drilled out from the underground opening. The tests were performed in rock materials which were beyond the range of any grouting which had been performed in the mine areas which were tested, and the permeabilities measured thus reflect ungrouted rock. 2. Pumping and packer tests in holes drilled from the surface by HydroGeo Consultants. These tests were performed in rock typically at least 1,000 feet from the mine, and thus beyond the range of grouting. The test holes themselves were not grouted prior to testing, 3. Permeability tests performed by Echo Bay Mines under the direction of HydroGeo Consultants in holes drilled into higher permeability materials in the Wolf Camp and Gravel Pit faults from the mine; these holes had not been grouted at the time of testing. In addition to using hydraulic conductivity tests from ungrouted rock, no changes were made to the model hydraulic conductivities of the materials near the mine to allow for any reduction of hydraulic conductivity which may result from grouting. In part as a result of this choice to ignore the grouting in the construction of the model, the flows which the model predict for the present time (115 gpm) are greater than the actually observed flow to the mine (17 gpm). Thus the model succeeds in being conservative by ignoring the grouting. Further, computations of environmental impact performed by Schafer and Associates using the high flows computed by ignoring the grouting indicate that there will be no significant impact of flow exiting the mine after closure. If the modeling had considered grouting, the result would have been an even lower impact, which would also have no significant impact.	3-30	3-30: According to EBM, grouting did in fact take place during 1994. EBM has provided some records documenting that numerous boreholes were grouted in 1994, and it is possible (although not documented) that some fracture zones may have also been grouted. If in fact, test holes for the June 1995 "2750 Level" report were emplaced in areas uninfluenced by grouting, then the 1995 model would have computed inflow rates based on hydraulic conductivities of the rock mass prior to and/or without grouting influence. The 1995 model predictions of inflow without grouting and would not have been directly comparable observed inflow, since observed inflow in 1994 was likely reduced by grouting. As noted in the June 1995 "2750 Level" report, Appendix A, "This reduction may also be a sign of the effectiveness of the grouting which is performed for all drill holes which make water, and for any significant inflow to the mine." (emphasis added). The report (Figure 2-8) indicates average annual inflow for the period from December 1992 through March 1995 averaged 6.3 gpm after including any grouting in 1994. Monitoring records indicate that prior to grouting in 1994, annual inflows averaged about 9.5 gpm. If pre- and post-grouting data are not averaged together, as was done in the 1995 report, inflow after grouting appears to have dropped to about 3.5 gpm, a reduction of over 60%. Compared to the pre-grouting inflows, flows in the same monthly periods post-grouting declined by about 32% to 88%. The effect of the 1998 grouting has also been documented by monitoring data (see Response 1-41). It is improper to compare modeled inflow for an ungrouted mine with the lesser observed inflow from a mine that has been partially grouted and imply that the greater inflows predicted by the model demonstrate greater conservatism (see response 3-24). Although the model may ignore grouting, actual grouting does influence the observed inflow.

Comment	Number	Agency Response
Respectfully submitted, **ADRIAN BROWN CONSULTANTS, INC.** **Adrian Brown, P.E.** **cc, S. McIntosh, Echo Bay Mining Company**		

Comment	Number	Agency Response

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MEMORANDUM

TO: Steve McIntosh Echo Bay Mines - Kettle River Operations

FROM: Vladimir Straskraba, TRC Hydro-Geo Consultants

DATE: August 12, 1998

SUBJECT: History of Grouting in the Mining Industry and Recommendations for the Lamefoot Mine

1.0 History of Grouting

Pressure grouting has been applied for water control and rock consolidation since early III the 19th century. Grouting, with the application of a range of grouting materials, such as clay, lime, cement, and chemicals, has been used successfully many times in ground consolidation and water control on dams, tunnels and mines. The applicability of each of' the grouting materials varies with the scope and size of the application, grouted strata characteristics, und Water quality.

Grouting practice for soil and rock stabilization and ground water control has a long history. .From a simple injection of bentonite and lime slurry for soil stabilization in the first

...[NOTE: original document was not provided to BLM and the remainder of this comment page submitted by Echo Bay was blank. The missing information was provided directly by TRC Hydro-Geo Consultants.]

Part of the 19th century to sophisticated injection of chemical grouts for historical building restoration and ground water control. Most of the applications of grouting technology in the mining and tunneling industry is based on cement, and cement-clay grouts. There are many technical papers describing successful application of grouting methods in mining and tunneling.

Application of cement-based grouts is more common in the mining and tunneling industry than use of other types of grouts. Numerous vertical shafts have been sunk under the cover of grouting. Methods of pre-cementation have been used extenwsively in South Africa, the United Kingdom, the former USSR, and also on several coal mine shafts in the eastern USA. Grouting from the bottom of shafts during sinking is a common practice in the industry for overcoming sections of shafts with poor ground conditions or an excessive ground water inflow.

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Page No. 2 In underground copper and gold mines, grouting is typically used to reduce ground water inflow where the drifts cross highly permeable aquifers, fault zones, and fracture zones. In some cases grouting is used to improve the ground conditions. The history of grouting being used for environmental safeguard mechanism is very limited.	4-1	4-1: Some examples of a recent applications for environmental control is described in McCloskey, 1996, "Innovative Approaches to Addressing Environmental Problems for the Upper Blackfoot Mining Complex: Grouting as a Hydrological Control for Acid Rock Drainage Reduction", EPA/625/R-95/007; and Ackman and Jones, 1988, "Stream Sealing to Reduce Surface Water Infiltration Into Underground Mines.
2.0 Application of Grouting in the Mining Industry The principal use of grouting in the mining industry is the reduction of ground water inflow into the mine. Grouting is typically applied during shaft sinking or during drift development. In many underground mines grout is used to strengthen the backfill materials, and there are only a few cases where extensive grout curtains were used for water inflow reduction. The primary scope of grouting is to reduce water inflow into a mine. In some cases, cement plugs (bulkheads) are used at the completion of mining to prevent water which is filling the mine from discharging into surface or ground water systems. Cover drilling and grouting is used in many mines where drifts are crossing water-bearing strata or faults. In these cases, the main scope of grouting is the safety of the mining operation. The history of grouting applications in mining and tunneling indicates that although properly designed and executed grouting can substantially reduce the water inflow into the mines, the complete elimination of water inflow into large mine workings is not possible. The fracture systems in the bedrock are typically so complex that a complete penetration into all fractures by grout is not achievable. Ground water, under certain pressure, can find some other pathways to penetrate into mine workings. Trying to achieve "a complete seal" would be technically difficult and the costs would be prohibitive.	4-2	4-2: See FEISS, discussion of grouting, e.g., Table 4.1-1, and EA document #50. To be conservative, the FEISS estimates only projected a 50% reduction in flow although substantially greater water inflow reductions are feasible. BLM concurs with your comment 4-4 regarding the potential to typically achieve 60-95% reduction.
An extensive grouting program could substantially reduce ground water inflow into a mine, and therefore, slow down the mine filling with water, however, a complete prevention of water seepage into the mine is not considered as a viable option. A mine slowly filling with water can cause more environmental impacts than one which fills faster (see Section 4.0).	4-3	4-3: Complete prevention of water seepage was not specified (see Response 4-2). Artificial refilling was discussed in the July 1995 "Impact Evaluation" report, Section 6.4, "The time to refill the mine could be shortened artificially by the addition of water to the mine void. This would have the benefit of reducing the time which the mine voids would be exposed to potentially oxidizing conditions, thus reducing the possibility of acid generation in the sealed-off voids. However, while the mine voids are not fully saturated they act as a drain for the local groundwater, and thus prevent outflow of mine void water to the environment. Artificially refilling the voids would more quickly return the groundwater heads in and adjacent to the mine to their approximately original conditions close to the ground surface. This would allow movement of entrained mine water downgradient to the west earlier than under unaided mine refilling. This option should be evaluated at the end of mining, when more will be known about the condition of the mine." Appendix B, p. B-5 also discussed artificial refilling. BLM's technical team examined this option but concluded that rock in the mine would already have been exposed to oxidation for at least 6-10 years by the time of mine closure and artificial refilling. Given the long lag time predicted for acid generation which would be offset by gradual refilling in approximately the same order of magnitude of time, it appeared that rapid refilling had potentially more disadvantages than advantages, as noted by the July 1995 Impact Evaluation report. As noted by Evangelou, 1995, "complete inhibition of pyrite oxidation by flooding may never be possible because of the availability of Fe^{3+} as an alternate oxidant. A field study by Foreman (1972), a laboratory column leaching study by Watzlaf (1992), and an O^2 free incubation by Pionke et al. (1980) have shown that when pyritic waste was flooded there was usually a significant, albeit incomplete reduction of acidity." This was described in the FEISS, p. 4-12, "The presence of only 0.5 mg/l dissolved oxygen, or moderate concentrations of ferric iron, or both, in these waters along with Thiobacillus bacteria, might cause sulfide oxidation to continue (Hutchinson and Ellison 1992)." The June 1995 "2750 Level" report noted in column tests of Lamefoot waste rock exposed about 2 years or less that, "reducing conditions ... could not be maintained after contact with the waste rock. Apparently, the waste rock has been sufficiently oxidized through exposure to the air that it becomes the dominant factor controlling the oxidation potential of the system." but that, "With continued flushing, reducing conditions might be established." EBM has never made a formal proposal for artificial refilling, but as noted in the 1995 report, examination of this issue would be better postponed until after mine closure when more is known about overall mine hydrology, since this issue was already examined in 1994 and 1995.

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3.0 Grouting Regulations and Efficiency of Grouting There are no well established regulations which state under what conditions grouting should be implemented. The application of grout is highly site-specific. However, there are no known projects in the history of mining where grouting could completely eliminate ground water inflow into a mine or shaft. The efficiency of grouting ranges typically from 60 to 95xxx reduction of water inflow. A considerable effort in the research of grouting has been completed while looking for available technologies to seal underground nuclear waste at Yucca Mountain, Nevada (Fernandez and Richardson, 1994). This study concluded that the technology to develop a complete seal and a demonstration of the long-term durability and performance of the seal components are not available at this time. In the Chinchilla underground copper mine at the Zambian Copperbelt, grouting is extensively used during mine development. The Konkola Mine is known as the wettest mine in the world, and up to 360,000 m3/day (66,000 gpm) of water has been pumped out of this mine. The rule for grouting in this mine during the drift mining is that cover boreholes are drilled and grouted until the total inflow into the drift face has been reduced to 2.1 m3/hour (9.2 gpm), (Straskraba. et. al, 199 1). Successful completion of grouting during shaft sinking was reported on many coal mining projects in Donets Coal Basin in Russia. Regulations in the former USSR required reduction of shaft inflow to less than 5 m^3/hour (22 gpm). This requirement has been met mostly by primary grouting and in several cases by secondary grouting (Kipko, 1989). At the Nagolchansk Mine in Russia, horizontal development from the shaft penetrated highly permeable sandstone at a depth of 690 meters from the ground surface. Grouting of this strata with the application of cement/clay grouts was completed by drilling grouting boreholes from the surface, on the 960 meter Level, and by drilling near horizontal grouting boreholes on the 960 meter Level. Both grouting operations reduced tile initial ground water inflow by nearly 95xxxX, (K.ipko, at al, 1984). In both cases the grout mixing was performed at ground surface and the mixture was pumped via high pressure pipelines underground. At the Clyde Power Dam project in New Zealand, drainage tunnels were completed to stabilize a large landslide. An extensive grouting program to reduce the seepage into the tunnels has been performed with the use of cement grout. Calculations of potential reduction of seepage	4-4	4-4: See Response 4-2. BLM appreciates your acknowledgment that the 50% flow reduction identified in the FEISS was a reasonable estimate and is actually less than been achieved at many other sites. The FEISS was premised on about a 50% reduction of flow, not on completely eliminating ground water inflow or outflow. The microfine grout analyzed in the Selected Alternative (alternative 5, p 2-25) and the 11/30/94 ROD was intended for deep penetration into the fine fractures at the Lamefoot Mine. The Type V cement presently being used is a coarser grout that will not achieve as deep a penetration. However, both types of grout are resistant to chemical attack by sulfate that will occur when the mine refills with water containing elevated concentrations of sulfate due to pyrite oxidation from the waste rock and crown pillar. See Response 1-39. BLM agrees that there have been numerous examples of successful use of grouting and appreciates the examples provided by the comment. Other examples include Kipko, et al., 1993, who provides information on grouting for a variety of purposes at 17 minesin the former USSR, as well as other facilities. Holl and Harte, 1981, describe grouting operations for shafts and tunnels in South Africa, with examples of the Libanon Shaft (in 1936), the Harmony Shaft (in 1957) and the Western Areas Gold Mine, among others. Nel, 1981, describes grouting for shaft sinking at the Elandsrand Gold Mine in South Africa. Greenslade, et al., 1981, describe grouting operations for shaft sinking at the Nose Rock Project in New Mexico, USA, to access deep uranium reserves. Grouting is routinely used effectively to reduce seepage in dams and tunnels, such as in the Seikan Tunnel under the Tsugaru Strait in Japan (Mochide, 1981). Grouting is a proven technology that has been in use for over a hundred years and has been proven to be effective in a wide variety of situations and applications.

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indicated that a 60% reduction of seepage could be achieved by grouting. The results of grouting were far superior to those expected from the calculations (Bromley and Glover, 1991, and Kovarik, 1998). At the Elliot Lake uranium mining area, a successful grouting project with the combined use of cement and chemical grouts has been reported (Carter et al., 1992). The underground grouting operation consisted of grouting large fractures with cement grout consisting of Type 3 Portland cement with up to 30% fly ash. The less permeable sections were sealed with the application of water reactive pre-polymer chemical grout, commercially known as TACSS. After the completion of grouting, boreholes from underground were drilled about 10 meters above the stopes. The performed grouting substantially reduced the mine inflow The Yakutiya diamond mine inflow was approximately 7,700 gpm before grouting was implemented (Kipko, Polozov, & Spichak, 1994). Grouting was also used at the Zhdanovskaya-Capitalnya Coal Mine, where inflow was approximately 740 gpm. The Zasyadko Coal Mine, where inflow was approximately 780 gpm, and the Nagolchanskaya 1-2 Colliery, where tip to 8,800 gpm was expected (Kipko, 1982). Hydro-Geo Consultants is currently involved in a water control study for the proposed Crandon Mine in Wisconsin. In this mine a large grouting curtain between the overburden and the mine is planned to reduce the ground water inflow into the mine. An extensive grouting program could reduce the calculated inflow by 60 to 70 %.	4-4	4-5: See Response 1-39. Based on the site specific review of this site, the 11/30/94 Record of Decision required use of high-sulfate-resistant cements capable of high penetration for grouting operations. Both ultrafine/microfine grouts and Type V Portland cement are sulfate resistant. See Response 4-4.
4.0 Impacts of Grouting on Water Quality Most grouting applications in the mining and tunneling industries use portland cement as a basic material. Neat grout comprised of portland cement and water are commonly used underground. However, mixes containing bentonite, a natural clay used primarily to reduce settlement of the cement particles in the grout, are recommended. Ultrafine cement grouts are used where penetration into fine fractures is required. Other types of-additives, as slag, fly ash, sand, tailings, and grout setting accelerators are also used in certain cases. The use of portland cement in mining applications, where drinking water could be impacted, was approved by Federal and State Regulatory Agencies. The use of certain	4-5	

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additives, as for example the fly ash, is limited in several states (i.e. Wisconsin), and a chemical analysis would be required prior to the application. 5.0 Recommendations for Grouting in the Lamefoot Mine The decision as to which boreholes should be grouted should be based on the following considerations: Safety of the mining operations; Potential impacts on water resources; Monitoring of water pressure and quality; Potential of seepage conduits after the mine fills with water.		
We believe that by grouting all boreholes discharging water in the mine, the hydrostatic pressure above the mine could reach levels which could impact the safety of the mining operation. Past experience indicates that even a relatively small discharge from a few in-mine boreholes can lower the hydrostatic pressure above the mine without causing any potential impacts on surface and ground water resources,	4-6	4-6: No safety problems have been identified and documented in the past from mining in the same area, nor were such issues raised in previous evaluations. BLM's primary concerns have been with the apparent total lack of grouting underground from 1994 to 1998 (see Response 1-32). The 1995 technical studies included six underground holes installed with packers and maintained for long-term monitoring, although some holes have reportedly been dewatered and are no longer useful (see June 1995 "2750 Level" report. Arrangements can be discussed for a few underground boreholes with packers for monitoring purposes. However, EBM has previously maintained an excessive number of packered holes in lieu of grouting (at least 37 ungrouted holes with packers, EA p. 15 from EBM records).
We also feel that several in-mine boreholes should be equipped for long-term monitoring of discharge mid pressure. This issue was discussed with a representative of BLM (Mr. Paul Summers) and he concurred with our opinion.	4-7	4-7: See Response 4-6.
Open underground boreholes can potentially provide a seepage pathway From the mine to outlying fractured zones, Boreholes that connect to productive fracture zones should be grouted. Indications of a productive fracture zone is one which not only produces initial flow, typically from storage, but a zone that is connected to a recharge source that flows continuously over time. Many boreholes intercept an initially productive fracture zone which drains to a zero or near zero flow after a short period of time. This type of borehole is connected to a limited fracture zone with a small storage value. If a borehole is connected to a continuous fracture system, flow will decrease to constant "steady state"; the flow rate that reflects the recharge potential of the overall fracture system. Steady state flows typically stabilize after a short period of time. Flow rates should be monitored monthly and flow rates and water quality should be reported to the	4-8	4-8: BLM agrees that the fracture system may have limited storage, but disagrees that quick drainage or failure to decrease to a 'constant "steady state"' discharge automatically means that there is no need for grouting. As noted in Response 1-39, to the best of BLM's knowledge, EBM and its' consultants have never conducted testing to show or define any aspects of the connectedness of flow systems associated with the complex faulting and jointing that exists at this site. As described the 1998 "Impact Evaluation", Appendix A, p. 10, "A drawdown cone has developed in the area immediately surrounding the mine workings (Figure 1). In general, the ground water gradient is steep in the vicinity of the Lamefoot Mine" and this drawdown was discussed in the EA, p. 12. Seasonal peaks in inflow are about 30 times greater than seasonal lows, indicating some connectedness of fractures with the surface (see EA Figure 10). There are several mechanisms that could influence potential for eventual outflow. Connections within a drawdown cone may not be readily apparent. With a drawdown cone of depression, fractures that are vertically connected may dewater at higher elevations as the mine deepens and discharge occurs at progressively lower elevations. Lateral flow may be limited within the upper parts of the drawdown cone and such fractures may only show a seasonal increase in flow when recharged from directly above by rain, snowmelt, etc. Similarly, boreholes extending to or near the surface within the drawdown cone may produce little water and may not even show substantive increase seasonal due to limited capture area at the surface, but such holes may allow outflow after mine refill. Also, the crown pillar is relatively thin throughout much of the mine (60-250 ft., EA p. 24), so any fractures through the crown pillar would naturally dewater quickly due to the relatively short fracture length. Nevertheless, when the mine refills, such fractures could provide a pathway for outflow. As a result, grouting may be needed in many areas that do not fit within the constraints of Comment 4-8. Also, EBM's discretion on grouting has proven unreliable (see Comment/Response 1-32), since apparently no underground grouting was performed from 1994 until 1998.

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grouting team. If the seep is determined to be connected to large permanent flow network, grouting should be considered. Boreholes that drain quickly should be considered safe if left ungrouted.	4-8	
We do not believe that small seep occurring in the mine (outside of the drilled boreholes) should be grouted. If a major water-bearing fault zone is encountered by the mining activities, which is not probable considering the degree of exploration drilling completed in the mine area, the fault zone could be effectively grouted by drilling and grouting boreholes, as has been done in the past.	4-9	4-9: See Response 4-8. The grouting procedures and requirements were developed in conjunction with the FEISS to provide a high degree of assurance that boreholes and faulted or fractured zones of rock would be adequately sealed to prevent outflow after mine refilling. BLM appreciates your opinion, but the FEISS was premised on EBM's commitment in the Proposed Action to perform grouting of such areas, and this was subsequently adopted in the 11/30/94 Record of Decision subject to changes in the grouting procedures incorporated in the Selected Alternative.
Therefore, as a conclusion, we recommend to grout only boreholes with a steady discharge which the hydrology and grouting team considers as appropriate candidates for grouting. Criteria used in elevation areas, follows: 1. Safety of mining 2. Potential impacts on water resources; 3. Potential for seepage conduits after the mine fills with water. Echo Bay should continue to monitor all seeps monthly for flow and field water quality parameters. Flows which are determined as significant permanent flow pattern will be evaluated by the hydrology and grouting team and recommendations for grouting will be submitted. Small seeps and a limited discharge from boreholes would not have a negative impact on the mine safety, water quality, and flow in the water bearing strata in the Lamefoot Mine area.	4-10	4-10: See Response 4-8 regarding EBM's past record of grouting choices. Grouting of such areas is required as part of the 11/30/94 ROD and the Plan of Operations.

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TRC Hydro-Geo Consultants 165 S. Union Blvd., Suite 400 Lakewood Colorado 80228 Phone: (303) 985-3433 Facsimile: (303) 985-3739 MEMORANDUM TO: Steve McIntosh, Echo Bay Minerals Inc. FROM: Joe Frank, TRC Hydro-Geo Consultants DATE: August 11, 1998 SUBJECT: Comments and Recommendations, Lamefoot Mine EA, No. EA-130-08-14 The following comments and recommendations refer to the Environmental Assessment (EA), No. EA-130-08-14, for the Lamefoot Mine Interim 3070/North Lamefoot Proposed Modification, Bureau of Land Management, dated July 24,1998. Pg 2, last para., line 6 ". . . the waste rock tonnage projections for future expansions need to be refined to determine their adequacy because they may be substantially low." JF: Why are the waste rock tonnage projections "substantially low"?	5-1	5-1: See EA Table 1 and Response 1-4: BLM has no idea specifically why the amount of discrepancy has been so great and suggests that you discuss this with EBM. EA Table 1 shows that EBM has consistently underestimated the PAG waste rock content by a wide margin (see Response 1-5, 1-7). The current PAG waste rock content in backfill is already about 450,932 tons as of the end of July 1998, and there is another year of mining left in the previously authorized areas that will produce more PAG waste rock. Any estimate based on drilling data for a rock mass composed of a variety of rock types is subject to some uncertainty, particularly since the actual locations of workings as constructed may deviate slightly from the initially planned configurations. This was taken into consideration in the analyses for the FEISS and 9/20/95 EA. EBM's tracking process is a reasonable means of verifying the lithologic content of the waste rock (see Response 1-6), and the method does add some uncertainty that was considered in the 12/12/96 Record of Decision.
Pg. 14, 1st para., line 3 "Drill holes were open into several water zones and producing water during drilling operations for over a month prior to the time discharge tests were conducted. As a result, much of the drawdown had occurred before testing was conducted, so actual flow rates were probably greater than estimated." JF: "probably greater than estimated" is speculation.	5-2	5-2: See Responses 1-35 and 1-36.
Pg. 14, 2nd para., line 16 "When the water zone was initially encountered by the first drilling operations, the head was over four times greater, so the initial flows probably exceeded 50 gpm per hole." JF: "probably exceeded 50 gpm" This is not substantiated.	5-3	5-3: You are correct that the drill crew did not record the actual water discharge at the time the water zone was initially intercepted for the holes with the greatest flows. However, given that the head at the time of initial interception was over four times greater at the time of testing, it is reasonable to project that the flow was greater and probably lasted longer. How much greater and how much longer has not been determined. See Responses 1-35 and 1-36.
Pg. 14, 7th para., line 11 "The grouting probably used Portland cement, which could deteriorate over time when exposed to mine water with high sulfate concentrations." JF: "probably used Portland cement" is speculation.	5-4	5-4: BLM agrees that there is some uncertainty regarding the type of grout used, but the history of the grouting supports that it was Portland cement. EBM did not maintain records of the actual grouting procedures, equipment or grout type used in 1994, or at least has been unable to locate such records and provide them to BLM. However, EBM has been able to provide shift reports documenting that some grouting took place from March through September 1994. BLM did have discussions with EBM about grouting throughout 1994, during which EBM proposed use of Portland cement. EBM worked with Woodward-Clyde Consultants to develop a draft Plan of Operations in July and August, 1994, that was used as a basis for the Proposed Action in the FEISS. The draft Plan of Operations stated, "Grout will be Type 1 cement...", and this was analyzed in the FEISS as the Proposed Action (p. 2-10) "The grout will consist of a variable mix of Portland cement...". EBM has never suggested that any other type of grout was used (e.g., chemical grout, clay). Since the draft Plan was developed at the same time as the 1994 grouting operations, it seems reasonable that EBM likely used the type of grout they proposed in the draft Plan.

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Pg. 14, 8th para., Lines 1, 4, and 5 "However, there are discrepancies about whether all holes were grouted. In 1998,.EBM reviewed their records and identified that 150 surface holes may have been grouted or plugged in 1993, and 391 underground holes may have been grouted or plugged in 1994 for a total of 541 holes. JF: Speculation about the number of grouted boreholes.	5-5	5-5: BLM agrees that the actual number of grouted boreholes has not been established and that is the reason for the discussion quoted from the EA.
Pg. 15, 3rd para., line 6 ". . . high potential may exist for interconnections that could allow outflow of mine waters after the mine refills. . JF: "high potential" unsubstantiated interpretation.	5-6	5-6: Fractures within the crown pillar and adjoining wall rocks are penetrated by hundreds of boreholes, establishing connections with those fractures. As noted in Comment 5-5, the actual number of boreholes grouted in 1994 is undetermined, but if it is less than 100% (i.e., all boreholes - see EA page 24) the potential exists for connections between the mine and the fractures. EBM has stated that no grouting took place between 1994 and 1998 (see Response 1-32) although monitoring records indicate new boreholes were drilled regularly from the surface and underground. EBM has not yet been able to provide documentation that surface holes have been grouted as required. EBM has reported that some surface holes have been intercepted by the mine workings in a fax on August 15, 1997, which stated, "Almost all the water encountered during development and mining has been in either excavations into surface drill holes or from delineation and exploratory holes drilled from underground." (emphasis added). BLM has observed flow into the underground workings from a hole reported by EBM to be a surface hole. Flow from a surface hole indicates that it either wasn't grouted, grouting was incomplete, or grouting had failed.
Pg. 15, 8th para., line 8 "Naturally-occurring nitrates are present in only low concentrations in background groundwater." JF: Hydro-Geo's report indicates that high levels of nitrates may be a natural occurrence not related to mining.	5-7	5-7: See Response 1-50.
Pg. 16, lst para. "Natural water quality exceeds numerical criteria for groundwater standards in most wells for one or more of the following JF: Elevated nitrate concentrations should also be listed.	5-8	5-8: It has not been established that elevated concentrations of nitrate in the monitor wells are due to naturally occurring nitrate. Mine workings were in existence prior to all wells except LF-1 and 2, and the mining process in 1992-1993 used ammonium nitrate blasting agent. At the time additional monitor wells were installed in 1994, mine workings were above the potentiometric level of the wells. Initially higher nitrate concentrations have declined in all monitor wells in the immediate vicinity of mine workings after use of ammonium nitrate blasting agent was discontinued. It is unclear whether the initially higher nitrate levels at some monitor wells was due to seepage from the mine or if the nitrate was naturally occurring. However, elevated nitrate concentrations have persisted at LF-8 and LF-12 downgradient from the mine facilities (infiltration pond, septic system, ore and waste piles).
Pg. 22, 2nd para., line 19 " - , stoping permanently exposes a large surface area (thousands of square feet instead of a borehole a few inches in diameter) and establishes extensive connections between the fractures and the stope void space." JF: "Extensive connections" is pure speculation.	5-9	5-9: Extensive connections is an established fact. The mine workings have already established conduits that directly connect all parts of the mine, with drifts and stopes extending through an area about 60 to 500 feet wide (east to west), in a zone ranging from drift height up to about 410 feet high that extends about 1000 feet vertically and almost 2500 feet long (north to south). The mine workings intersect thousands of fractures, many of which would not have been directly connected due to their orientations but are now connected by the mine workings and will have a source of water after the mine refills. Seasonality of inflow through the crown pillar indicates connections between the mine workings and the surface via fractures in the crown pillar.
Pg. 23, 8th para. "Figure 16 illustrates the locations of most existing groundwater monitoring wells and new locations of possible stations being, considered for the monitoring system. ." JF: BLM refers to "possible stations being considered for the monitoring system." In the mitigation section, these stations are suddenly required?	5-10	5-10: As discussed with EBM and Hydro-Geo, additional monitoring is required under the 11/30/94 ROD to address gaps in the monitoring network. However, the specific locations of the stations noted on EA Figure 20 may be adjusted slightly to accommodate site specific conditions, access, etc. and there will be further discussion with EBM and Hydro-Geo on specific locations.
Pg. 27, 6th para., line 8 "At the present time, it appears that there are slight offsite impacts to ground water in the alluvium due to elevated levels of nitrates." JF: Our study indicates that nitrates may be naturally occurring. P. 3	5-11	5-11: See Response 1-50. That is not an accurate statement of the report conclusions. The report by TRC Hydro-Geo Consultants titled "Lamefoot Mine Nitrate Analysis ... Final Report, July 10, 1998" concludes, "The combination of high nitrates and fecal Coliform in LF-8 indicates an impact by human, livestock, or wildlife sewage. Since there is no livestock and little wildlife activity near LF-8, the source of fecal Coliform is probably from the Lamefoot septic system. The septic system is hydrogeologically up-gradient of LF-8. Other potential contributing sources of nitrate, up-gradient of LF-8, are the infiltration pond, waste rock stockpiles, and ore stockpiles." The septic system, infiltration pond, waste rock stockpiles and ore stockpiles all involve "mining-related activities". This further corroborates the monitoring data and the report by EnviroData Solutions, Inc. indicating that elevated nitrates in LF-8 and LF-12 are likely due to mining-related facilities and activities.

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Pg. 45.- 44 (Proposed Action) Specific locations, depths, and other details about proposed monitoring stations should be left out of the text. It would be better make this very general, indicating that additional monitoring sites will be determined after further analysis. We believe that the recommended monitoring stations are in good locations, however, the same coverage could be achieved with fewer wells.	5-12	5-12: The locations, depths and other details about monitoring are part of the implementation of the 11/30/94 Record of Decision. During meetings and discussions with the public and other agencies for the 1992 EA and 1994 FEISS, these parties requested to be kept informed about the Lamefoot Mine throughout operations. As noted on EA page 1, "The need for the current EA originally arose from review of monitoring data". Under CEQ regulations 40 CFR § 1505.3, "Mitigation (§ 1505.2(c)) and other conditions established in the environmental impact statement or during its review and committed as part of the decision shall be implemented by the lead agency", and the lead agency shall "make available to the public the results of relevant monitoring" and "inform cooperating or commenting agencies on progress in carrying out mitigation measures which they have proposed and which were adopted by the agency making the decision." BLM included information on implementation of mitigation measures in the 1998 EA to provide the public and other agencies with a comprehensive project update of the cumulative effects and mitigation, rather than focusing on just the one incremental expansion that was added to the analysis (see EA page 1).
General comment regarding proposed monitoring sites; we do not feel that proposed wells LF-15, 16 and 17 are necessary under Alternative 1 (no action) or for the Proposed Action. These wells are too far north. They seem more appropriate for Alternative 2. Wells LF-19 and 20 could be moved about 500 to 1,000 feet north and eliminate the need for LF-18. Any new monitoring well location should be placed as far west down the ridge as possible to reduce drilling depth. Many of the proposed sites are located too far east. A full suite of water quality parameter may not be necessary at all sites to achieve the desired results. This should be reviewed and discussed before it is listed in a public document.	5-13	5-13: LF-15 and LF-16 are westward of the northern end of the 2225N exploration drift, which has already created drawdown impacts north of those sites. LF-14 is located between the mine and the Curlew Lake Fault southward of LF-15; the drift extends farther to the north and closer to the fault. In evaluating evidence of drawdown effects associated with the 2225N drift and the Wolf Camp Fault, the TRC Hydro-Geo's report "Addendum To The North Lamefoot Hydrogeologic Study" (November 1997) stated that, "This demonstrates a direct hydraulic connection through the fault zone between LF-14 and the underground drill holes." LF-15 and LF-16 were proposed by TRC Hydro-Geo, to monitor water quality of westward groundwater flow at the northern end of the project area. Hydro-Geo postulated in the Addendum report that, "the Curlew Fault could act as a barrier or impede ground water flow from the Lamefoot Mine area to the west." There is no supporting evidence for this theory because no groundwater data has been collected previously from that area to determine the actual conditions on the fault, no such data has been presented to BLM, and the situation could just as easily be the opposite, i.e., the Curlew Fault could transmit water or act as a preferential pathway with connections with the Wolf Camp Fault either downdip or via a cross-fault. Since there is essentially no information on the Curlew Lake Fault, none of these possibilities can be substantiated or refuted. Therefore, in addition to monitoring for potential groundwater impacts at the north end of the project area, LF-15 and LF-16 are needed to verify flow conditions at the Curlew Lake Fault. LF-17 is located just north of the existing impact area from the 2225N drift, and those impacts could potentially extend farther north under either the Proposed Action or Alternative No. 2. LF-17 provides a means of measuring impacts that may preferentially extend northward along the Wolf Camp fault zone.

COMMENT	Number	AGENCY RESPONSE
EnviroData Solutions, Inc. Helping you work smarter, August 11, 1998 Cliff Ligons Bureau of Land Management Spokane District Office Border Resource Area 1103 N. Fancher Spokane, WA 99212-1275 Re: Comments on Lamefoot Mine Environmental Assessment Dear Mr. Ligons: EnviroData Solutions, Inc. reviewed the Environmental Assessment and recommends the BLM make the following modifications to the Recommended Mitigation Measures section. 1. EA Recommendation: The BLM recommends monitoring for the long list of parameters as defined in the 11/30/94 Record of Decision at now wells and surface water sites. Suggested Modification: Monitor for the parameters outlined in Table 1. Table 1 is comprised of the long list parameters minus those metals and general parameters that have yet to be assigned a Washington ground water standard and have yet to be consistently observed above detection limits after three years of sampling. The Hydro-Geo et al., 1995 impact evaluation, updated in 1998, predicted that copper, zinc, cadmium, arsenic, sulfate, and manganese would be potential parameters for concern after mining operations have ceased. These parameters are included In Table 1.	6-1	6-1: Background data is collected to establish a baseline for each monitoring station prior to impacts that may occur after the mine refills. Since the mine is currently functioning as a sump and water is not generally flowing out through the bedrock, concentrations in most wells should be at or near background concentrations. Detecting elevated concentrations of paramaters during operations would not be expected at many of the stations. Wells downgradient from the ore and waste rock stockpiles, septic system, and infiltration pond may show some impacts during operations, along with wells in Wolf Camp valley downgradient from the mine (e.g., during early stages of operations before mine workings deepened below valley level. EnviroData's Table 1 seeks to reduce the number of parameters in the analytical program by eliminating orthophosphate, fluoride, oil & grease, antimony, barium, chromium, nickel, silica, and thallium. EnviroData's Table 1 purports to exclude those metals and general parameters which do not have Washington ground water standards and have not been consistently observed above detection limits. However, several of the omitted constituents do in fact have Washington ground water standards by automatic inclusion of more recently promulgated Federal Safe Drinking Water Act Primary and Secondary Maximum Contaminant Levels (MCLs)(see WAC 173-200-040(2)(b)(iii): "The criteria for primary and secondary contaminants and radionuclide contaminants in Table 1 shall be amended as the federal and state rules are amended and without amendment of this chapter."). These constituents include antimony, barium, chromium, and thallium (primary MCLs), and fluoride (secondary MCL). Moreover, antimony has been observed above the MCL in groundwater in the North Lamefoot area (and should be added to the short list, at least for the wells in the North Lamefoot area), and most of the others have been observed above detection limits. This leaves only orthophosphates, oil & grease, nickel, and silica as constituents which would be omitted according the EnviroData's proposed criteria. As EnviroData notes in their comments, impacts are not expected to be detected at most monitoring stations until after the mine refills, although some stations may detect impacts during operations. Monitoring during operations is used to determine background concentrations and establish baseline levels and trigger limits for corrective actions. Monitoring is needed now before impacts occur, since these determinations can require several years of monitoring data to accurately assess the conditions. Although the models predict that only certain constituents will be elevated, those predictions have not been verified and verification will not be possible until after the mine refills and the actual reactions take place. Post-closure monitoring required by the 11/30/94 and 9/20/95 RODs includes internal monitoring within the mine to determine the actual parameters that develop elevated concentrations. The list of parameters can be adjusted, if needed, after the mine refills and model predictions have been verified.
2. EA Recommendation: The BLM recommends monitoring for the long list of parameters. This long list includes total metals. Suggested Modification: Sample for the dissolved form of the metals listed in Table 1. We demonstrated in the 1997 Annual Report that total metal values were unreliable. Ground water sampled for total metals are poured without filtration 15405 SE Stevenson Drive Vancouver, WA 98683 ph. 360-254-1608 fax, 360-892-5818 email: jwoodward@envirodatasolutions.cam	6-2	6-2: The monitoring parameters were developed in consultation with the Washington Department of Ecology (WADOE) to meet Washington State groundwater monitoring requirements. This has been discussed numerous times at length with EBM. While BLM appreciates your concerns, total metals provide a better representation of mine water quality. Total metals are required under State groundwater standards, and absent a change in State standards, there will be no consideration of eliminating the requirement to analyze for total metals. Analysis for dissolved metals also provides useful information, and the WADOE has provisions for determining if there is a correlation between total and dissolved metals, as noted in the ROD. The difficulties mentioned in the comment indicate that sampling procedures should be carefully carried out to minimize complications in the analysis (see WADOE implementation guidance for the ground water quality standards). EBM will need to obtain WADOE concurrence before BLM will consider changing the frequency for analyses of total metals.

COMMENT	Number	AGENCY RESPONSE
into a sample bottle containing nitric acid preservative. The acid dissolves metals from any suspended sediments into the sample water, High TSS samples will therefore, result in high total metals concentrations. Sampling can stir up sediments in the wells, resulting in high TSS values. Therefore, total metals are artificially inflated and are inappropriate for monitoring and for comparison to standards.	6-2	
3. EA Recommendation: The BLM recommends monitoring the proposed wells monthly for the long list of parameters. The stated objectives for monitoring ground water levels is to determine flowpaths and to determine whether Curlew Lake Fault is a barrier to groundwater flow. The stated objective in monitoring for the long list of parameters is to identify any potential changes in water quality. Suggested Modification: We agree with the BLM recommendation to take monthly groundwater level measurements. However, we do not feel that monthly monitoring of water quality parameters is necessary. Quarterly sampling both during and post mining for Table 1 parameters is adequate for identifying potential changes in water quality. Any potential changes in water quality are not anticipated until mining operations; are discontinued. During mining, water from the surrounding rock flows into the mine. Mine water is pumped out and hauled to the tailings pond. Until the mine refills post mining, there is no hydraulic head to push water out of the mine towards the wells. Quarterly monitoring during should, therefore, be adequate to establish baseline conditions. Once the underground workings refill with waste post mining, there is a potential for water to seep from the underground workings. Despite the potential for seepage, quarterly monitoring would still be sufficient to identify any areas for concern since the bedrock surrounding the mine is relatively impermeable.	6-3	6-3: BLM appreciates your concurrence with the need to obtain monthly groundwater level measurements. The point of monthly data collection for both water levels and water quality is to quickly gather background data to establish baseline groundwater elevations and water quality parameter for each sampling station before these situations may be impacted. This process can take several years. The mine is scheduled to close in one to two years, and will begin refilling soon after mine closure. At the time of closure, the hydrologic monitoring plan calls for preparation of a comprehensive data evaluation and summary report to correlate baseline data in order to be able to identify potential future impacts and to determine any follow-up corrective measures needed for existing impacts from the operational (mining/production) phase. All new stations will need to be fully integrated into the monitoring network by that time. Quarterly water quality samples starting at this time would yield an insufficient number of samples (e.g., 4 to 8 samples) to conduct an adequate background determination. Background is determined statistically for each location and more data points are necessary to develop robust statistics that can take into account the natural variations present at each site. The ROD would provide for collection and analysis of at least 12 samples over the next 24 month period using the complete list of water quality parameters for determination of background water quality.
4. EA Recommendation: The BLM recommends the installation of six wells for monitoring groundwater levels, as well as water quality parameters on the long list. The stated objectives for monitoring ground water levels is to determine flowpaths and to determine whether Curlew Lake Fault is a barrier to groundwater flow. The stated objective in monitoring for the long list of parameters is to identify any potential changes in water quality. Suggested Modification: Monitoring two wells as proposed by Hydro-Geo in the Addendum to the North Lamefoot Hydrogeologic Study, November, 17, 1997, one to the east and the other to the west of the Curlew Lake Fault, for Table 1 parameters would be sufficient for meeting the stated objectives. Well locations and construction specifications need to be discussed and mutually agreed upon by BLM and Echo Bay.	6-4	6-4: See Response 5-13: Wells LF-15 and LF-16 only identify characteristics of flow across Curlew Lake Fault at one location at the northern end of the mine, and may not be representative of conditions along the entire length of the fault between the mine and Curlew Lake. Therefore, two sets of paired wells/piezometers were identified to evaluate conditions of the fault downgradient from the mine - one set at the northern end (LF-15 and LF-16), the other set near the southern end of the mine (LF-19 and LF-20). As noted in EA Section 6.13.1, specific locations and construction specifications would be determined based on field review and consultation with BLM. This aspect of the sitings would take place in conjunction with EBM's consultants. Monitor wells MSWOB 1 & 2 will be used together with LF-6 to gain information on the flow across Curlew Lake fault. MSWOB 1 & 2 have been part of the existing monitoring network since 1995, but monitoring data for these wells was not delivered to BLM until October 19, 1998, and the data that was provided is missing information for numerous sampling intervals. The ROD proposes pairing existing wells MSWOB 1 & 2 and LF-6 to gain information on a head comparison across the southern portion of Curlew Lake fault. Additional water quality sampling will also be needed for MSWOB 1 & 2 to provide an adequate determination of background water quality and comparison with other the other monitoring wells.

COMMENT	Number	AGENCY RESPONSE
5. EA Recommendation: The BLM recommends monitoring two seeps, SP-2 and SP-3, monthly to collect six samples, at a minimum, to measure parameters from the long list. The stated objective is to identify changes in water quality. Suggested Modification: Monitor for Table 1 parameters twice a year, once during high flow and again during low flow. During mining, the elevation of the mine workings is below the elevation of both seeps. One would not expect any outflows from the mine workings to reach the seeps. Monitoring during the high and low flows should be adequate to determine baseline conditions. Furthermore, the mine is dewatered during mining so the mine would not be expected to be a source of outflow. It will not be until post mining when the mine refills with water that the seeps could register potential changes in water quality due to mining. By monitoring during the high and low flow, we will have an opportunity to observe the maximum variability in the water quality.	6-5	6-5: See Responses 6-1 and 6-3. These sites have not been monitored before. Unless the sites are monitored regularly at initially closer intervals, selecting a date to take measure high and low flow would simply involve guesswork that would most likely be incorrect. It is important to establish an accurate monitoring period at the start to determine the background characteristics of the seeps and establish baselines for future monitoring. Initially takings samples and measurements at monthly intervals will make it possible to determine the high and low flow periods and how constituents vary with water flow. See 1998 ROD, Conditions of Approval 4 & 11.
6. EA Recommendation: The BLM recommends monitoring Wetland 4 for the long list of water quality parameters. Suggested Modification: We suggest that a one-time sampling event for Table 1 parameters be conducted on the same day at Wetland 4 and LF-12, which is situated adjacent to Wetland 4. Sample results would establish whether or not Wetland 4 is in direct communication with the ground water. It should be emphasized that the water quality sampling should be conducted on the same day and that water level measurements be taken at both sites. If Wetland 4 is in direct communication with the ground water, sampling should be discontinued at Wetland 4 as long as quarterly sampling for Table 1 parameters was continued at LF- 12. If Wetland 4 Is not in direct communication with the ground water, sampling at Wetland 4 should still be discontinued. It would be unnecessary to sample a pond that has no recharge from or discharge to ground waters and whose water quality is believed to be affected by evaporation.	6-6	6-6: Well LF-12 has exceeded State primary drinking water standards almost continuously since its installation. The State of Washington (Department of Ecology) recently issued Order No. DE 98WQ-E382 citing EBM for exceeding the ground water quality standard for nitrates. See EA document #31 and Responses 1-50, 1-53, and 1-56. Installation of LF-12 took place after the mine facilities had been in place and operating for almost 3 years, so it is possible that the area was contaminated by mining sources prior to installation. A one time sampling would not clearly establish the results indicated by the comment, nor has monitoring data substantiated the conclusions stated by EnviroData. There is no data to indicate that Wetland #4 does not discharge downgradient toward Curlew Lake, and that is the direction of the regional gradient. BLM does concur, however, that Wetland #4 and LF-12 should be sampled on the same day.
7. EA Recommendation: The BLM recommends monitoring Wetlands 1 and 2 for the long list of water quality parameters six or more times. The stated objective is to identify changes in water quality that may occur during post mining as the mine working fill with water. Suggested Modification: Monitor monthly for water levels, but limit monitoring frequency for water quality parameters to quarterly. The water quality monitoring should be further limited to three field parameters, pH, conductivity, and water temperature.	6-7	6-7: See Response 6-3. Water quality data is needed to determine background water quality and establish baselines for monitoring stations before there are potential impacts from post-closure discharge from mine workings. Mine closure is anticipated in one to two years, and refilling will start soon after closure. In addition, it appears possible that mine facilities may already be impacting wetland water quality (see Responses 1-50 and 1-53).

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During mining, the elevation of the mine workings is below the elevation of both wetlands. One would not expect any outflows from the mine workings to reach the wetlands. Therefore, water quality should not be affected during active mining. Post mining, the projected elevation of the water in the mine will be below the elevation of Wetlands 1. Therefore, one would expect this wetland to have no impact on water quality post mining. Monthly monitoring for water levels and quarterly monitoring for the three field parameters mentioned above would be adequate. Furthermore, the mine is dewatered during mining so the mine would not be expected to be a source of outflow. It will not be until post mining when the mine refills with water that Wetlands 2 could register any potential changes in water quality caused by mining. However, these same changes, if they occur, will be observable in the adjacent alluvial wells, LF-5 and LF-7. Therefore, there is no need to monitor Wetland 2 for the long list of water quality parameters. Wetland monitoring for field parameters should be performed at the outflow from each wetland to avoid sampling stagnant water.	6-8	6-8: See Responses 6-1 and 6-3. Effects in alluvial wells may not be directly correlated with effects to wetlands. See EA Section 6.11.1 for a discussion of concerns about wetland #2. Water quality changes could potentially effect Carex sychnocephala.
Regards, John R. Woodward		
Table 1: Recommended Life of Mine Monitoring Parameters. Lists 35 monitoring parameters and associated rationales for using those parameters.	6-9	6-9: See Responses 6-1 and 6-2.

Comment	Number	Agency Response
OFFICE OF THE RESERVATION ATTORNEY Confederated Tribes of the Colville Reservation P. 0. Box 150 Nespelem, Washington 99155 James "Rit" Bellis, Attorney Marla Big Boy, Attorney Tim Brewer, Attorney Peggy Circle, Secretary Karen Condon, Researcher Ramona LaSarte, Paralegal Teen Stanger, Assistant David Shaw, Attorney Stephen H. Suagee, Attorney Bonnie Timentwa, Secretary August 14, 1998 Mr. George Brown Lamefoot Mine NEPA Team Leader Mr. Cliff Ligons Border Area Resource Manager Bureau of Land Management Spokane District Office 1103 N. Fancher Spokane, WA 99212-1275 Dear Mr. Brown and Mr. Ligons: Pursuant to our conversations yesterday, I am sending you this written request to extend the comment period on the EA and proposed FONSI on the Lamefoot Mine (No. EA-130-08-14) (hereafter Lamefoot EA). I believe an extension of the comment period will allow more time for reviewing some of the fundamental NEPA and Indian law issues surrounding the Lamefoot EA. As I stated yesterday, the Confederated Colville Tribes (CCT) have grave concerns regarding both the sufficiency of the specific findings of the Lamefoot EA and the process in which it was prepared. Regarding the process in which it was prepared, CCT believes that inadequate consultation with CCT has occurred based on three distinct legal avenues: 1) NEPA consultation requirements; 2) Federal trust responsibility consultation requirements; and 3) government-to-government consultation requirements stemming from Executive Order titled "Consultation and Coordination with Indian Tribal Governments." An initial review of the Lamefoot Mine shows that insufficient consultation occurred between CCT and BLM. Several reasons for this conclusion are detailed below.	7-1	7-1: The inadvertent omission of the CCT from the list of governmental parties was an error. Consultation with the CCT in each of the mentioned categories has occurred throughout the environmental reviews of the Lamefoot project, including the 1992 EA, the 1994 FEISS, the 9/20/95 EA, and the current 1998 EA. Past CCT comments have been taken into consideration and the BLM has independently carried out trust responsibilities, e.g., for issues relating to hunting, fishing, and water resources, even in the absence of comments from CCT on such issues. The comment period was not extended because an extension would have involved substantive delays that could have adverse impacts on existing mine operations. Nevertheless, while formal comments from the comment period were being analyzed, additional government-to-government consultation has taken place to ensure that due consideration would be given to the interests of the CCT in this area. As acknowledged in a subsequent letter from the Office of the Reservation Attorney dated August 31, 1998, "Although an initial review of the Lamefoot Mine EA Plan of Operations Modification (No. EA-130-08-14) appeared to demonstrate that inadequate consultation with CCT had occurred, upon further review of supplemental documents provided by your office we concur that a satisfactory level of consultation has occurred."
1. Section 7.0 of the Lamefoot EA titled "Agencies and Organizations Consulted" lists several governmental bodies consulted such as Ferry County, City of Republic, State of Washington, but does not mention CCT in any manner or form. This statement omitting CCT from the list of governmental parties consulted by BLM appears conclusive in itself, but is supported by further evidence below.	7-2	7-2: CCT was inadvertently omitted from the list of "Agencies and Organization Consulted" in the 1998 EA, but the CCT was consulted. A government-to-government meeting between BLM and the CCT took place on April 21, 1998. The CCT was also notified of the NEPA evaluation. Discussion of surface resources was brief because the 1998 EA is tiered to the 1994 FEISS and the 9/20/95 EA. The EA (p. 12) mentions consideration of Native American Religious Concerns. Issues raised in CCT's comments and subsequent government-to-government consultation have been considered in the analysis.
2. CCT's reserved water rights are not mentioned anywhere in the analysis of environmental affects stemming from the proposed action. Although the proposed Lamefoot Mine activity will take place outside of the reservation boundaries, this is not the determinative test regarding whether an activity will infringe upon the reserved water property rights of a Tribe. The Lamefoot EA is completely void of any analysis, or Telephone: (509) 634-8834 Telefax: (509) 634-8538	7-3	7-3: The 1998 EA is focused rather explicitly on re-examination of specific issues relating to potential water quality impacts. The 1998 EA is tiered to previous NEPA analyses, which discussed issues relating to the Colville Reservation. The 1994 FEISS specifically examined potential impacts to the reservation via the San Poil River. The 1994 FEISS response to comments #3-4 stated "The Lamefoot mine is not hydrologically connected to the Colville Confederated Tribe's Reservation and, therefore, potential groundwater contamination is not addressed as a possible cumulative impact. However, the Key Mill - a connected action - does have the potential to impact groundwater quality on the Reservation. As noted in Section 4.1.5, the mill and tailings facility was previously permitted by the Department of Ecology (DOE)(Washington Waste Water Discharge Permit No. 8033) and a comprehensive monitoring plan, including monthly reporting, is already in place. The responsibility for monitoring of water quality in the tailings area rests with the DOE." The 1998 EA, Figure 11 (p. 16a) illustrates the drainage basin for Curlew Lake and the specific watershed associated with the Lamefoot Mine. A branch of the North Fork of the Sanpoil River flows northward to Curlew Lake, and Curlew Lake flows northward to the Kettle River.

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subsequent finding that CCT's reserved water rights are not implicated. This involves both an analysis of the San Poil Basin and other sources of groundwater with hydrologic continuity with water used on the reservation.	7-3	7-3 (contd.): Juul, 1988, notes that "not all of the water originating in the Sanpoil drainage basin flows into Lake Roberta and Curlew Lake. Just east of where the river flows under State Highway 21, it splits and a portion flows north into Lake Roberta; the remainder flows south." BLM has inspected this drainage basin divide and verified that a branch of the North Fork of the Sanpoil River flows northward, while the remainder flows southward. Juul, 1988 also notes, "Lake Roberta and Curlew Lake were originally two separate lakes. In the early 1900's, however, a channel was dug between the lakes so logs could be floated north to the Karamin Mill. Except for this channel, the two lakes are apparently separate hydrological entities."
3. CCT's hunting and fishing rights within the boundaries of the old reservation (the North Half, stemming directly North of the current reservation boundary and extending through to the Canadian border) are not mentioned anywhere in the analysis of environmental affects stemming from the proposed action. As you may be aware, these rights were specifically reserved in the 1891 agreement between the federal government and CCT and further upheld in the Supreme Court case of Antoine v. Washington. As you may be aware, tribal rights to hunt and fish carry with them a corollary right to habitat protection surrounding these rights. Analysis of environmental affects to habitat stemming from CCT's right to hunt and fish in the North Half are missing from the Lamefoot EA, in addition to any finding that these hunting and fishing rights will not be affected.	7-4	7-4: Wolf Camp valley is an ephemeral drainage that is dry most of the time, with a few localized wetlands. Most water flow in the valley is subsurface, except for Wolf Camp spring. As noted in the 1998 EA, most constituents in the mine water would be fully chemically attenuated alone in groundwater before reaching Curlew Lake; dilution would reduce the remainder prior to reaching Curlew Lake. Concerns identified in the EA are the possibility of impacts to wetlands (e.g., sensitive status plant species) and domestic water supplies from wells located between the mine and the lake. Fish resources would not be impacted by the Lamefoot Mine. The 1998 EA (p. 29) notes, "The 1995 studies identified that if any unmitigated constituents from diffuse outflow through bedrock were to reach Curlew Lake, the amount of dilution at the lake would be so great that it is unlikely that the amount of water from the mine would have any measurable impact to lake water quality. The main concern would be whether dissolved constituents might impact drinking water quality at private wells for residences and resorts located between the lake and the mine." For example, CCT comments mentioned concerns that cadmium concentrations in waters occupied by salmonids should not exceed 0.0004 mg/l (see Response 3-21). As noted in EA Table 6, the initial cadmium concentrations for the first pore volume of mine water are predicted to be 0.0004 mg/l cadmium inside the mine before any attenuation. By the tenth pore volume (i.e., in 100 to 500 years; see EA p. 36), concentrations of cadmium in the mine pool might only reach 0.006 mg/l under the modeled scenarios. As noted in the EA Table 9, a range of at least 6 to 23 times dilution is anticipated between the mine and the lake, and at the lake an additional 4000:1 dilution would occur. This substantial dilution would reduce cadmium concentrations at Curlew Lake to concentrations well within acceptable exposure levels for fish. Therefore, no impacts to fisheries due to cadmium are anticipated at Curlew Lake. The FEISS found only relatively minor (low adverse) impacts to wildlife. For example, the FEISS found, "There will be a minor loss of mule deer winter range, but this loss is offset or even exceeded by the habitat quality improvement resulting from the removal of livestock. Deer are not currently avoiding this area, even though it is very close to the activities and buildings at the core shed and office complex." Livestock grazing was voluntarily halted on the private property in the project area to offset impacts during operations, but may be resumed after mine closure at the discretion of the private landowner. No substantive impact to wildlife or hunting are anticipated from operations. As noted in 40 CFR 1502.2(b) "Impacts shall be discussed in proportion to their significance. There shall be only brief discussion of other than significant issues."
Additional issues regarding further time to resolve include whether "official consultation" between BLM and CCT occurred through the proper channels and procedures of the CCT government.	7-5	7-5: See Responses 7-1 and 7-2.
As you are aware, NEPA law holds that an agency's decision not to prepare an EIS will be considered unreasonable if the agency fails to supply a convincing statement of reasons why potential effects are insignificant. Further, an agency's decision is given judicial deference only when it is fully informed and well-considered. The failure of the Lamefoot EA to consider a significant segment of information necessary to NEPA (impacts on the environment related to CCT) would render this EA void.	7-6	7-6: Impacts to CCT have been considered. The 1998 EA is tiered to the 1994 FEISS and 9/20/95 EA.
Further, Indian law concerning the federal government's trust responsibility holds that a federal agency has a duty independent of NEPA to investigate and consider the impacts of proposed actions on tribes. Moreover, the latest presidential Executive Order mandates a government-to-government full consultation process must occur between the federal government and each tribe. The BLM's failure to consider and fulfill its duty under trust responsibility and Executive Order demonstrate a clear breach of duty.	7-7	7-7: See Response 7-1. BLM believes it has carried out its trust responsibilities, and CCT has concurred that adequate government-to-government consultation has taken place. BLM has thoroughly evaluated potential impacts that could effect the CCT.
This letter is sent merely to request more time to comment so that more information may be brought to light on the preceding issues. Without additional comment time, further steps in resolving these issues will be necessary, including the initiation of any necessary legal action. I can be reached at (509)634-8834 with any comments or questions. Sincerely, David D. Shaw Enclosure P.S. For your review, I have enclosed a case on NEPA and the federal trust responsibility.		

APPENDIX II

Lamefoot Mine
Plan of Operations Modification
WMP-130-89-019B

FINDING OF NO SIGNIFICANT IMPACT
(FONSI)

LAMEFOOT MINE
ENVIRONMENTAL ASSESSMENT
EA-130-0-08-14

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Based on the analysis of potential environmental impacts contained in the attached environmental assessment, I have determined that the impacts associated from mining expansions (exploration, development and mining activities), as mitigated, are not expected to be significant, and therefore an environmental impact statement is not required. This applies to both mining expansions described in the Proposed Action and in Alternative 2, Enlarged Interim Expansion. Mitigation includes the measures identified in the 11/30/94 Record of Decision as modified by the 9/20/95 Record of Decision and implemented by the 12/12/96 Record of Decision, and additional mitigation addressed as Recommended Mitigation in the 7/24/98 Environmental Assessment.

RATIONALE: The analyses that have been conducted since completion of the November 1994 Lamefoot Mine Environmental Impact Statement support the conclusion that the mine water would likely remain in the near-neutral range during filling, and that acid-generating reactions would be controlled by the mitigation measures after the mine partially refills to the elevation of Wolf Camp valley. The mine may refill to higher levels, depending on the degree of outflow through bedrock, but it appears unlikely that the mine may completely refill as analyzed in 1995. Mine waters may exit through the crown pillar through faults, fractures or ungrouted boreholes, preventing complete refilling.

Grouting measures required in the 11/30/94 Record of Decision should be capable of controlling seepage and discharge. Mitigation measures would neutralize acid generation and maintain concentrations of dissolved constituents in mine water at levels somewhat higher than naturally elevated pre-mining conditions. Most dissolved constituents would be retained within the mine pool or within the project area immediately surrounding the mine if all operational mitigation measures are carried out in an effective manner. Remedial grouting of boreholes and fractures is being conducted in 1998 to address past omissions. If discharge does occur, other mitigation measures in the 11/30/94 Record of Decision would be implemented to prevent impacts outside the project area, such as corrective post-closure grouting from the surface, and if necessary, installation of a treatment plant and drawdown of mine waters.

The modifications described in the Proposed Action and Alternative 2, the measures required by the previous RODs described above, as incorporated in the plan of operations, and the additional conditions of approval proposed in the 7/24/98 EA would likely ensure prevention of most possibilities for unnecessary or undue degradation, although there are some uncertainties in predictive capabilities and mine conditions. The mitigation measures are designed to address these uncertainties. This proposal is in conformance with the 1985 Spokane Resource Management Plan, as amended, and the review has been coordinated with other Federal, State, local and Tribal governments and agencies.

Clifford D. Ligons
Field Manager, Border Resource Area

Nov 16, 1998
Date

END

04-8-02